SECOND FLOOR

FOUNDRY TRADE JOURNAL

EST. 1902

VOL. 107 WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

No. 2234 OCTOBER 1, 1959

Registered at the G.P.O. as a Newspaper Offices: John Adam House, John Adam St., London, W.C.2

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FOUNDRY
TRADE JOURNAL

Vol. 107. October 1, 1959 No. 2234

Established 1902
Incorporating
IRON & STEEL TRADES JOURNAL

Single copy 1s.; *by post* 1s. 4d. *Annual subscription: home* 52s., *abroad* 60s. (*prepaid*)

Editor:
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Publisher: H. J. DWYER
Circulation Manager: E. T. GRIFFITHS

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The FOUNDRY TRADE JOURNAL is the official organ of the British Steel Founders' Association; Association of Bronze & Brass Founders; the Light Metal Founders Association; Foundry Trades' Equipment & Supplies Association; and the National Society of Master Patternmakers.

AN INDUSTRIAL NEWSPAPERS PUBLICATION

Published Every Thursday by Industrial Newspapers, Limited

BARRINGTON HOOPER, C.B.E.
Chairman and Joint Managing Director

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Joint Managing Director and Commercial Director

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17-19, JOHN ADAM STREET,
ADELPHI, LONDON, W.C.2

Telephone: Trafalgar 6171 (*Private Branch Exchange*)
Telegraphic Address: "Zacatecas, Rand, London."

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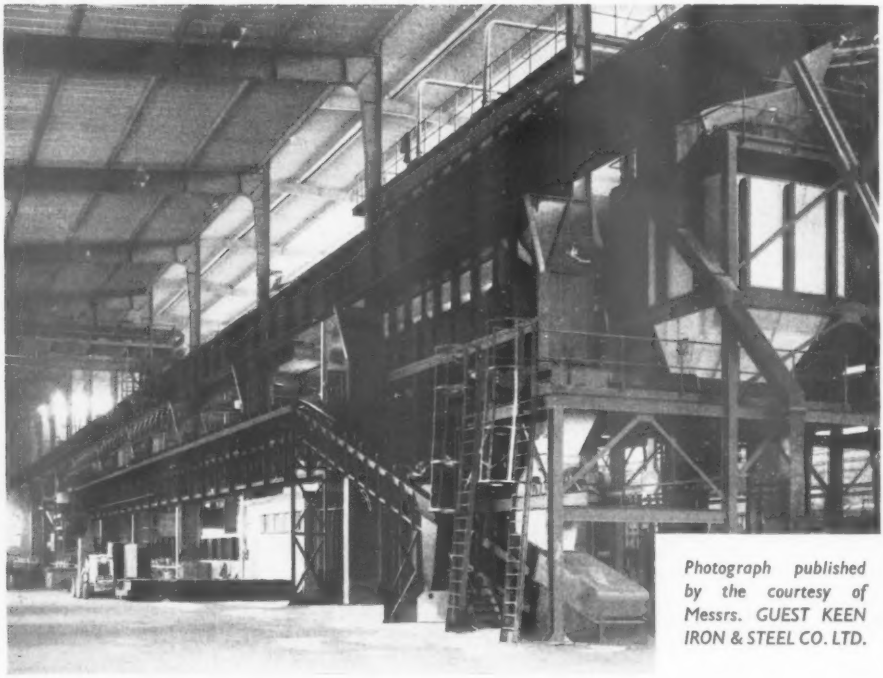

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FOUNDRY
TRADE JOURNAL

Vol. 107 OCTOBER 1, 1959 No. 2234

Two-hundred-and-fifty Years

This year is being marked by celebrations of two events which took place a quarter of a century ago. The first, of more academic interest, was the birth of coke-fired blast furnaces and the second, the formation of the Coalbrookdale Company. The former was commemorated last week by the presentation of a number of lectures, a banquet and a visit to the works at Coalbrookdale. The second is being marked by the opening at the Coalbrookdale works by Allied Ironfounders, Limited—the parent company—of a museum and a furnace site, the latter being used in its archaeological significance because actually " old " and " new " furnaces have been laid bare by excavation. This alone makes the exhibits of outstanding interest to all those who seek to enhance their knowledge of the history of ironfounding. The excavated and restored area together with the excellent museum which has been formed and is now open to the public, will make Coalbrookdale a Mecca for industrial historians for evermore.

It is difficult to establish from the records available whether or not Abraham Darby I was the first man to use coke as fuel for a blast furnace, as in 1709 metallurgical experiments were not publicized. However, as his furnace was used for the dual purpose of making pig-iron and cast iron, at the very least he can be credited with this notion. He started casting in the January and no doubt accumulated stocks of pig-iron. Whilst direct metal was probably used for the making of heavy-section castings, remelted metal was preferred for making his light-section cooking pots. No doubt, also, the size of the stockpile would, to a large extent, govern the furnace charge for any particular melting programme. It would seem that this early " marriage " of iron and steel with the foundry industry has never, in the eyes of those outside these industries, resulted in a divorce, so that only too often the two industries are regarded as one.

The papers presented on the 250th anniversary of the successful use of coke in ironmaking form an invaluable and readily available record for those of future generations who are delving into the history of the industrial revolution. From one of these papers, it is made clear that Abraham Darby I was also the father of the UK brassfoundry industry. This work was carried out at Bristol, where he not only made brass pots and pans, but also established a wire industry. There are many facets worthy of study in the various documents issued in connection with these celebrations, such as the benefits to be derived from the solution of transport problems, the employment of the best artists of the day as industrial designers and adaptation to modern conditions. If, unlike Wilkinson, the Darby family had had no religious scruples and had manufactured armaments, we wonder if the wealth which would have accrued would have resulted in further important industrial developments.

Combustion Engineers' Conference

The technical and economic aspects of the use of automatic controls on medium-size and solid-fuel-fired boiler plant, and the development and improvement of fully-automatic coal-fired boiler plant are subjects which will form the basis of papers and discussions at the Conference of the Combustion Engineering Association to be held at the Royal Hotel, Scarborough, on November 3 and 4. The Conference is to be opened by the Worshipful Mayor of Scarborough, Councillor J. Kennedy, J.P., at 9.30 a.m. on the Tuesday, and in addition to technical sessions, a civic reception (by the Mayor and Corporation of Scarborough at 8.30 p.m., on November 3), and a dinner (8.0 p.m. at the Royal Hotel on November 4) will be included in the event.

Opening speakers will deal in general with automatic operation of boiler plant, and give requirements to be fulfilled, subsequent speakers will deal with the technical aspects, and a final session will be devoted to an economic assessment of the use of automatic handling and control equipment. Papers to be presented include: "Why Automatic Operation" by R. H. E. Thomas; "What is Needed to achieve Automatic Operation," by B. E. A. Vigers; "Fuel and Ash Handling" by F. S. Stent; "Combustion and Mechanical Firing" by M. V. Murray; "Automatic Control Equipment," by J. S. Hales; and "Present-day Practice in Automatic Control," by I. W. Stevenson. Whole sessions will be devoted to discussion of the papers.

Founders have a dual interest in the Conference, first in the technical aspects of combustion efficiency and instrumentation, and second, that automatic-firing plant for using coal inevitably involves the considerable employment of cast components. The Conference will be open to non-members, and those wishing to participate should make early application to the secretary of the Association at 70, Jermyn Street, London, S.W.1.

Forty Years Ago

An article in the October 1919 issue of the JOURNAL carried the title "Foundry Comparisons" and in it the author, Mr. H. G. Barrett, described and illustrated an atmospheric feeder-head which, apparently, was re-invented during the second world war by American foundry research workers. Mr. Barrett, however, failed to disclose the fundamental principle of the system, for he described the connection between the feeder-head cavity in the mould and the open air as a vent, instead of a channel through which atmospheric pressure could exert its effect. Amongst new companies listed in this issue were Greenside Foundry Company, Limited; Premier Aluminium Casting Company, Limited; Foundrometers, Limited; and G. M. Hay & Company, Limited (registered in 1939)—the first Meehanite licensee.

Latest Foundry Statistics

Copper-base Castings: That there has been no improvement in the production of copper-base castings is shown by the latest figures published in the *Bulletin* of the British Bureau of Non-Ferrous Metal Statistics. The July output was 5,720 tons and for the first seven months of the year it was 42,365 tons. The latter figure compares with 42,897 tons for the corresponding figure of last year.

Forthcoming Events

OCTOBER 3

Institute of British Foundrymen

Wales & Monmouth branch: Works visit to Black Clawson International, Limited, W. A. Baker section, Newport, 2.45 p.m.; tea at 5 p.m., followed at 6 p.m. by "Modern Methods in Pattern Production," by B. M. S. Perry

OCTOBER 5

Institute of British Foundrymen

Sheffield branch: Presidential address and dinner at the Sheffield and Ecclesall Restaurant (details from secretary).

OCTOBER 6

Institution of Plant Engineers

Edinburgh branch: "Changes in Factory Legislation," by A. Gow (H.M. Inspector of Factories), 7 p.m., at 25, Charlotte Square.

OCTOBER 7

Combustion Engineering Association

Scottish region: Brains Trust on "Clean Air and Industry," 10 a.m.; 2 p.m., Discussion on "Instrumentation and Smoke Control," opened by P. J. Turner. Meeting to be held at the Grand Hotel, Charing Cross, Glasgow.

Institution of Production Engineers

Dundee section: Numerical Control of Machine-tools," by Mr. Brett and Mr. Tack, 7.30 p.m., at the Windmill Hotel, Arbroath.

Institute of British Foundrymen

Southampton section: "Some Aspects of Small Foundry Practice," by F. P. Robinson, 7.30 p.m., at the Technical College, St. Mary's Street.

Institution of Plant Engineers

Southern branch: "Town Planning and the Location of Industry," by R. J. Roddis, 7.30 p.m., at the Polygon Hotel, Southampton.

OCTOBER 8

Institution of Production Engineers

Leicester section: Evening visit (7.15 p.m.) to the Imperial Typewriter Company, Limited, East Park Road, Leicester, followed by lecture "Production-control System at the Imperial Typewriter Company," by B. S. Pears.

OCTOBER 10

Institute of British Foundrymen

Scottish branch: Presidential address followed by "Some Aspects on the Manufacture of Cast-steel Axle Boxes," by J. McConnell, 3 p.m., at the Royal College of Science and Technology, Glasgow.

POA Annual Conference

Speaking at the recent annual general meeting of the Purchasing Officers' Association, held during the Annual Conference at Folkestone, Mr. W. H. Parry, national chairman, said that there had been a substantial increase in membership, and this despite the fact that steps were being taken to base entry upon examination qualification. More than 1,000 registered students were now preparing for the examinations. He went on to say that during the year, a certificate in store-keeping had been introduced and in addition the Association had continued to provide a programme of senior courses. The Association had also continued to be active internationally and had played a leading part in the formation of the European Federation of Purchasing.

In his presidential address, Mr. C. F. Huebner called buyers' attention to the dangers of over-ordering, and pointed out that past experience showed that high stocks were accompanied by long delivery dates. The service factor in buying was also one which should never be neglected. He concluded by referring to price cutting, which he thought should not be carried to extremes, although buyers should lose no reasonable opportunity for keeping prices down.

Coalbrookdale 1709 to 1959

By Dr. A. Raistrick

This history of Coalbrookdale Company, Limited, of Wellington, Shropshire, covers a period of two-and-a-half centuries—their 250th anniversary cannot but give pause for reflection on the progress that has been made during that period. Few industries can look back on greater changes than have been experienced by iron founders. To mark their appreciation of the company's long and distinguished record, Allied Ironfounders, Limited, have made possible the preservation of the Darby Old Furnace (1777), and the display of some of the Company's records and achievements. The following article is an abridged version of Coalbrookdale's life story, as told in a brochure issued by Allied Ironfounders.

The first Abraham Darby, who founded the present works of Coalbrookdale Company, Limited, came from a family whose home was at Sedgley near Dudley. His grandfather and father, both called John, had worked a small farm and carried on the trade of locksmith, and his father had joined the Society of Friends called Quakers. His mother and stepmother were also Quakers. Born in 1678 he was apprenticed in 1691 or 1692 to Jonathan Freeth of Birmingham, also a Quaker, a maker of malt mills and small machinery. In his apprenticeship Darby became familiar with two matters which were to be of great importance in his later work, the art of working iron and steel and the use of coke as fuel in malting. In 1699 he married Mary Sergeant and moved to Bristol, where he set up first as a malt-mill maker, then in 1702 formed the Bristol Brass Wire Company in partnership with a number of other Quakers. Two years later he turned his attention to the making of brass pots, then after a visit to Holland began the experiments which finally led in 1707 to the patent for casting *iron* bellied-pots in dry sand, and in particular to the art of casting them thin and light.

ABRAHAM I's FIRST STEPS

In 1708 Abraham was looking for a furnace of his own to develop ironfounding, and after examining the furnace in Coalbrookdale, took it on lease, and in the next year began to smelt iron ores using coke as his fuel. The success early in 1709 of this new method is one of the events being celebrated in this year 1959. The choice of Coalbrookdale, which he heard of from Richard Corfield, was probably influenced by Darby's knowledge of the coke made from one of the coals occurring there, the Clodd coal, and also by the town's position on the excellent waterway of the Severn, which linked it with the group of Quaker merchants in Bristol who were already interested in the iron trade. Coalbrookdale had been an area of ironworking and making long before Darby knew it. In 1638 Sir Basil Brooke had a furnace built in the Dale (the Old Furnace) and smelted iron ores with charcoal by the same methods he had used for twenty years at his furnaces in the Forest of Dean. The furnace had a chequered career until the great floods of 1706, when the pool dam burst and the furnace flooded and blew up, so that when Darby took it over he had to do considerable repairs to the hearth, and provide new bellows. In the country in and around Coalbrookdale there were at that time at least eleven forges, which took some iron from local furnaces and supplemented this with pig-iron from the Forest of Dean. When Darby repaired the furnace in 1708 and began casting pig-iron in 1709 he used his output for casting pots and other articles, and for a small supply to Bristol. He did not enter into trade with the local forges.

Birth of "Family" Tradition

Darby no doubt employed some of the men who had worked at the old furnace, but he also brought some of his own workmen with him from Bristol and so introduced names which are still remembered in the area. His stepmother was Joan Luccock, John Darby's second wife, who came with her

The picture at the top of this page shows a cast-iron statue, 7 ft. wide by 8 ft. high, of Cupid and the Swan. Originally made by the Coalbrookdale Company for the Great Exhibition of 1851, it now stands near to the 1777 old furnace.

husband to the Dale in 1709, and her nephew, Thomas Luccock, was, in 1714, indentured to Abraham Darby I. In the nineteenth century the family was still in the district and Ann Luccock became the mother of W. G. Norris, a manager of the Company, members of the Luccock family having worked in the Dale for over two centuries. The families of Thomas and Rose also came with Darby. The fact that many of the workpeople were Quakers, and that there was some degree of relationship between many of them, helped to establish the friendly "family" tradition that has always been characteristic of the works. Abraham Darby, amidst all the activity of establishing the business, was very active in the affairs of the Society of Friends attending meetings in Newport and Broseley, where the Meeting House was built in 1690. The business of the meetings brought him into close and frequent contact with many Friends such as the Lloyds, Crowleys, Milners, Osbornes, Goldneys and others who were also interested in iron, and he had many opportunities to talk over things with them. There is abundant evidence that the group of Quakers in the Severn and Border country and in North Wales formed a closely bound community within which there was a considerable interest in iron making and the iron trade. Abraham I died in 1717 and was buried in the Broseley Meeting House Ground, leaving his widow with six children, survivors of the ten born to them. Mary, the eldest, married Richard Ford, clerk in the works, and on her mother's death in 1718, she took the oversight of the children with Richard Ford, Thomas Goldney and Joshua Sergeant as Trustees for them. Ford took the management of the works in partnership with Thomas Goldney, who came up from Bristol for a while, and under their care the works were extended. When Ford entered on the management an inventory was taken which gives a good idea of what buildings there were in the works and helps to picture the general appearance of the Dale. There were now two furnaces, for Abraham I had started to build his second, the Lower Furnace, in 1715; there were three moulding shops, three air furnaces, a warehouse, a smiths' shop, carpenters' shop, dressing room, store room, a copper house, office and a few other small buildings. There were also three forges, the "Lower Forge" forming the nucleus of Dale End.

Steam-engine Castings

The work of founding was shared between the two furnaces and the three air furnaces, and pig-iron, pots, pipes and pumps were being produced. Before long the first steam-engine cylinder was cast at the Old Furnace. There was now the prospect of an increased trade, as the steam engine was well established in the mining fields, and cylinders of cast-iron were much cheaper than the earlier ones of brass. The demand for pig-iron among the Bristol merchants was growing, and the pot trade was extending both by sales to smaller customers at the fairs and to a few wholesale customers like the Champions, Ives, Jukes and others. Ford and Goldney leased two new furnaces, Bersham and Willey, in 1732 and so released the Old Furnace for the expected steam-engine work, transferring some of the pot casting to Bersham. The men in charge of the Old Furnace were now Crannage and Parker and at the Lower Furnace, Onions and Slicer. It was the foresight of Ford and the financial help of Goldney that brought the concern through a period of difficulties and experiments into a successful condition in the middle 1730s.

ABRAHAM II

Abraham II left school and went into the works. In 1732 he began to act as assistant to Ford, and in 1734 was a partner in the new tenancy of the works; in 1736 he was brought into full partnership and the business was renamed the Dale Company. Edmund Darby, brother of Abraham II, had a small interest in the works and acted for some time as a traveller to the fairs, but developed a business of his own as a general merchant which he continued alongside his work in the Dale Company. He was killed in a riding accident in 1756.

Steam Pump Installed

During Ford's management there were some important changes in the works; the furnaces had formerly worked to a great disadvantage because of an insufficient water supply through part of the year, which meant that the bellows could not be worked to the capacity needed for a full blast. Ford built horse-driven pumps which returned water from the tail of the wheels into the ponds, so that it was used over and over again. Abraham II, in 1742, replaced the horse-driven pumps by some driven by a steam engine which was built in the works. He also took over part of the management in 1738 and during the next 10 years secured leases of iron and coal mines in Lawley, Dawley, Lightmoor and Coalmoor. In 1748 he began the construction of wooden wagon ways between these and the works. This was the beginning of the extensive system of wagon ways which Richard Reynolds, 20 years later, relaid with the world's first cast-iron rails.

Gun Trade Stopped

During the management of Ford and Goldney the company took part, for a few years, in the unQuakerly gun trade, but when Abraham II took charge the casting of guns was stopped. The demand on the furnaces was increasing and in 1755 and 1756 Abraham II had new furnaces built at Horsehay and Ketley, and in the next few years at Madeley Wood, Dawley Castle and Donnington Wood, and made in them a pig-iron suitable for conversion to bar iron. Some of the best known ironmasters of the Midlands, Knight, Foley, Lloyd and others, became his customers, and forges were developed at Horsehay and Ketley so that the company now had three large works as well as iron and coal mines, and was one of the largest in the country. Richard Reynolds came from Bristol in 1756 and took over the management of the Ketley works.

Workers' Houses Built

With the great increase in the number of workmen, Darby turned his attention to their social needs. In the succeeding years he and Reynolds built many groups of workpeople's houses in the Dale, at Horsehay and Ketley, and a little later, on the New Dale estates at Dawley. The Friends Meeting House in Coalbrookdale was built in 1745 and extended in 1763, another being built at New Dale in 1759. The building programme had already included schools, repairs to a schoolhouse being mentioned in the accounts as early as 1718, and throughout the company's history, the education of its workpeople's children was cared for. An idea of the appearance of the Dale can be obtained from the Plan of Coalbrookdale 1753, which is still in the works. A great mass of buildings was clustered around the Upper (Old) Furnace in the area between the Upper Pool Bank and the present road through the works leading on to Darby Road; this is the area now cleared as a surround for the Old Furnace. In the furnace area the crowded mass of buildings included air furnaces, moulding shops, blacksmiths' shops and many other small buildings. Next in the Dale below Upper Furnace came the Lower Furnace Pool, and the Lower (New) Furnace with its moulding houses, warehouse and blacksmiths' shop. The Upper Forge Pool, the largest of the three pools, separated Lower Furnace from the Upper Forge. Wagon ways ran all through the works and down the road to Lad Croft Wharf (sometimes known locally as Severn Wharf), and up the Dale into the Loam Hole, and also by Jigger's Bank to the many iron and coal pits beyond the Dale Head.

ABRAHAM III TAKES OVER

Abraham II died in 1763, but from 1756 had the help and friendship of Richard Reynolds, who married his daughter Hannah in 1757 and in 1762 bought a half share in the Ketley works. Reynolds took over the management of all the works until Abraham III was of age in 1768, when he returned to the management of the Ketley works. In the years 1758 to 1768 the company was expanding beyond the Dale with forges at Bridgnorth and Liverpool and agents in Cornwall, London and Newcastle-upon-Tyne. The forge at Liverpool, founded in 1758, became eventually the engineering firm of Fawcett-Preston, while the Carron Ironworks was started in 1759 with the help of skilled workmen from Coalbrookdale, one of whom later took part in the Perran Foundry development in the south. By 1758 the company had cast more than 100 steam cylinders, and had built a great many complete engines. Abraham III continued his father's interest in this work, and found an able supporter in Richard Reynolds' son William, who took the management of Ketley about 1777, and who, with Darby, built several Boulton & Watt engines for the works, under licence from the patentees.

World's first Cast-iron Bridge

The event most publicized in this period of the

View of Abraham Darby's "Old Furnace" (glass roof added) and its surrounds at Coalbrookdale, in Shropshire.

Abraham Darby's "Old Furnace," as seen from the casting floor. It was redesigned in 1777 for casting the iron bridge for the River Severn.

Works' story was, of course, the building of the Iron Bridge over the River Severn, the first cast-iron bridge in the world. It was cast at the Old Furnace, and after its erection the Gold Medal of the Society of Arts was presented to Abraham Darby. It seems now fairly certain that the bridge as it stands was Abraham's design, but the idea of using cast-iron for a bridge probably belongs to the architect Pritchard. It was for the bridge castings that the Old Furnace was re-designed and built in its present form. Abraham I's furnace was on the same site and was essentially the original charcoal furnace of 1638, repaired and improved time after time. The foundations now exposed on the west side of the base of the Old Furnace probably belong to the 1638 structure. The rebuilt furnace incorporated cast-iron beams from the first one, with the cast-on inscription B E w 1638 E w B, though the letter B is seen really to be a monogram combining a B and an L, and the w is probably a crown. The newer beams carry the inscription ABRAHAM DARBY 1777. The members for the bridge structure were cast in open sand moulds on a floor prepared on the east side of the furnace, and the method of their casting can still offer a puzzle to the founder who considers their great length of 70 ft., and their small section, with the great uniformity which their heavy loading demands. Some 378 tons of members were sent from the Dale to the site of the bridge, and for three months the work of erection went on "without any accident either to the work or the workmen, or the least obstruction to the Navigation of the River." After the bridge was opened, it became one of the sights for tourists, and many famous people visited it and made notes and descriptions in their diaries. This was the beginning of a long connection with bridge building, the Buildwas Bridge and the Albert Edward Bridge, also over the Severn, being two local examples of which the former has been replaced by a newer structure.

Inventions

The reputation of Coalbrookdale was growing among engineers, and many experiments were made there both by people in the works and by visiting engineers who brought their ideas to be tried out. Adam Heslop, who was apprenticed in the works, invented the Heslop engine, of which several were made and used about the Dale, then set up a business for himself in Cumberland and supplied numbers of his engines to collieries in the North of England. Sadler, the first balloonist, had his invention of an improved steam-engine built in the Dale, and several of these were made for use at the works and collieries throughout Shropshire. Visiting engineers included such men as Hornblower, with his improved steam-engine, and Telford and Trevithick.

Telford

Telford, who came to the area in 1787 and got to know the Company while acting as Surveyor of Public Works for the County of Salop, was responsible for the county bridges. The inclined planes were invented by William Reynolds in the course of the canal which he was building for the Company; they were used for lowering boats from one level to another of the canal, or from the canal to the river side. Of equal importance was the cast-iron aqueduct made by the Company to carry the Shrewsbury canal across the valley of the Tern at Longdon, the success of which persuaded Telford to use cast-iron troughing on his famous Pont Cysylte and Chirk aqueducts on the Ellesmere canal.

Trevithick

Trevithick knew the Dale through its steam-engines, which were working at many Cornish mines, and through his friendship with the engineer Hornblower visited the district in 1796. After his famous road-engine experiment at Redruth, on Christmas Eve, 1801, he came to the Dale in January, 1802, to test his high-pressure boiler and engine. The Company had made boiler plates for half a century, and their haystack boilers were widely known. Trevithick wanted to build a locomotive to run on rails. In 1802 folk in the Dale, with a crowd of local engineers, were able to watch the splendid performance of the high-pressure boiler and engine made for Trevithick, which in part of the test took steam at 145 lb. per sq. in. pressure, which was incredible at the time. The locomotive was built, and was the first successful locomotive built to run on rails, thus creating another world record for the Company. Others were built for Trevithick and for the Company's own use, and an engine was even tried out in a boat, which was propelled at seven miles an hour. In the years following these experiments the Company built many high-pressure engines on the Trevithick plan.

REORGANIZATION AFTER ABRAHAM III's DEATH

When Abraham III died in 1789 the finances of the Company were in a poor order, as they had kept clear of work connected with the war, which could have brought them large profits. Richard Reynolds helped them with big loans and easy leases, and in 1790 some reorganization was started. Richard Dearman became manager until 1803 when Edmund Darby, nephew of Abraham III, took charge. Dearman's sister was daughter-in-law of Richard Reynolds, so Dearman was not a stranger to the family of Darby. He had been partner and manager of Dearman & Freeth, of the Eagle Foundry, Birmingham. In the next few years there was a thorough reorganization of Coalbrookdale, Horsehay and Ketley and their associated mines and furnaces, and in 1797 the Ketley section was renamed W. Reynolds & Company, though Coalbrookdale held half the shares and there was joint management. Horsehay and Coalbrookdale were united under a new name, "The Coalbrookdale Company." The works were now equipped as follows:

Coalbrookdale: small furnaces, foundry, light rolling-mills and forge, engine shops and timber yard.

Horsehay: larger furnaces, heavy rolling-mill and forge, boiler shop and brick yard.

Ketley: furnaces, light rolling-mill, engine and wagon shops.

Associated with the works were also a larger group of furnaces with two at each of the following places, Madeley Wood, Lilleshall, Donnington Wood, Dawley Castle and Lightmoor. Engine work was mainly done at Coalbrookdale and Ketley, and blooms were rolled at Coalbrookdale and Horsehay. The rolling mills had been built at Coalbrookdale in 1784 and at Horsehay and Ketley in 1789. At Horsehay boiler-plates were being rolled, a most important innovation which soon led to an extended activity. The Company had a steady output of boilers, many of them made to the customers' drawings or special requirements, and many of large size.

Period of Distress

In 1795 and 1796 there was throughout the country a period of distress caused by high prices and scarcity of food—in some parts there was rioting among workers. The Coalbrookdale and Ketley Companies, along with two neighbours, the Old Park and Snedshill firms, subscribed £8,000, with which stocks of rice and corn were purchased and resold to the workpeople at three-quarters of the cost price. The Dale Corn Mill was built to produce flour from the corn and so avoid any exploitation by millers. This help in obtaining reasonably priced food, along with the many allotments provided by the Company, helped the steady work of reconstruction to proceed without any rioting in this area.

Temporary Close-down

Until 1810 the works was kept busy with a variety of productions: engines, pig-iron, bars, castings, pots and hollow castings. However, by 1812, there was a period of depression in trade and the Coalbrookdale furnaces were closed down, along with one at Horsehay, while Ketley works closed down in 1816. Francis Darby, son of Abraham III, had been in charge at the Dale from 1810 and it is to him, after the long depression, that credit goes for one of the best known of Coalbrookdale's special lines, that of art castings. Richard, his brother, took part interest in the Dale, but was more actively busy in work for the abolition of the slave trade, and in other philanthropic causes. In 1810 Horsehay and the outlying furnaces were put in charge of Edmund Darby's brother-in-law, Barnard Dickinson, who managed them until 1827. Dickinson had the hard task of carrying these works through a period of great depression, and only succeeded in this by introducing many economical methods of working and by extending the variety of work undertaken. While Horsehay was kept in full work the Dale works were somewhat neglected, and experienced their quietest period until a revival began about 1833; it had even been suggested in 1825 that Coalbrookdale might be given up and all the work concentrated at Horsehay and Lightmoor. Two years later, however, a lease of the whole concern was renewed.

Developments at Horsehay

At Horsehay, Abraham IV and Alfred, the sons of Edmund Darby, followed Barnard Dickinson as joint managers and very soon developed their own particular interests. Abraham took a keen interest in the mines and in all technical problems, and Alfred turned to the forge, foundry and office side, so that between them they made an excellent working partnership. The work was departmentalized, and foremen and heads of departments spread responsibilities more widely among the workers. With about 2,000 employees, some social problems soon became pressing. More houses of a better type were built for the workers, and to keep up with the building programme a new brickyard was opened up on the Pool Hill estate.

FRANCIS DARBY

Art Work

At Coalbrookedale, a long period of depression was ending in the 1830's, and Francis Darby now extended the Company's activities on what had been for nearly a century a minor line of production. As early as 1731 a large consignment of pallisades, pillars, rails, scrolls and spears had been cast for Preston Hospital, and the interest in railings and other architectural cast-iron work had continued in a quiet way, which made it easy for Francis to expand to the heights of the Hyde Park Gates and the Vienna Exhibition Gates. Francis, with his great love of art, expanded the foundries in another branch, that of casting figures and sculptures, and introduced good artists, some from France, to improve the designing section. In 1849 the Company was awarded the Gold Medal of the

Part of the new museum at Coalbrookdale Works, illustrating various aspects of the long tradition of ironmaking in the Dale.

Society of Arts for their castings, and approached the Great Exhibition of 1851 with considerable enthusiasm, and a very varied group of exhibits. The great fountain "Boy and Swan," designed by John Bell, stood near the gates now generally known, from their position, as the Hyde Park Gates. The fountain, after a chequered career among Wolverhampton parks, is now re-erected in the grounds of the Old Furnace at Coalbrookdale. The quality of much of the modelling of the art castings was very high, and a statue of Andromeda, cast in iron from the design and model of John Bell, is now in the Coalbrookdale Museum. Apart from these large works, a great number of small objects were cast, many of them of beautiful design: small busts, plates, statuettes, and even pictures, such as the famous "Last Supper."

Inexhaustible Field of Application

Towards the mid-century there seemed to be an almost inexhaustible field for the application of cast-iron—railway stations, house balconies, bridges, staircases, fireplaces, even shop fronts were made up of cast members, and much furniture for house, office and garden was made. In the introduction to the Coalbrookdale exhibits, in the Great Exhibition catalogue, it is stated that the Company employed between three and four thousand men and boys at Coalbrookdale and Horsehay. The output was 2,000 tons a week, and the works were then the biggest ironworks in the world. While the art castings took the popular fancy, the Company was producing a great range of rolled bars and sections, structural members, beams and columns, lamp-posts, machinery, engines, pots, stoves and fireplaces, and in fact every kind of hardware that could be made in cast-iron, from chimney pots to grave stones. For the material shown at the Great Exhibition the Company were awarded a Council Medal. These Medals (only 170 were awarded as compared with 2,918 Prize Medals) were for some "important novelty of invention or application, either in material or process of manufacture, or originality combined with great beauty of design." The exhibits were seen by more than six million visitors, and among nearly 14,000 exhibitors those receiving Council Medals must have been outstanding. To meet much of the increase in foundry work which Francis and Alfred achieved, the great warehouse, built in 1790 at Coalbrookdale, was brought into full use, and the fine cast-iron clock tower was added in 1843. This building is in itself of excellent design, and is noteworthy for its extensive use of cast-iron, both structurally in columns, and in the graceful lintels and sills of doors and windows and the window frames, all in cast-iron.

THE NORRIS ERA

In 1849 Abraham IV and Alfred I had nominally retired from the works and removed from the area, and Alfred died in 1852. Francis died in 1850, so that in some ways the mid-century marked the end of an era. The chief designer, Charles Crookes, carried on the management, but without the necessary technical knowledge of iron-making was unable to make improvements, or even maintain the necessary standards at the furnaces and forges. However, he kept the works going, extending the art-casting sections so ably started by Francis. In 1866 William G. Norris was in a position to take over the management of all departments of the works. Norris was brought up in the Dale, and was of a Quaker family which had long connections with the district, his father being at the works before him. Under his management, while the art casting continued by the momentum and reputation it had gained under Francis Darby and Charles Crookes, other sides of the Company's activity were remodelled or extended. Conditions were not very happy at Horsehay, where the quality of the forge iron had been allowed to deteriorate. Foreign ores were brought in to be mixed with the local ones, and the furnace regulation was overhauled so that the highest quality of iron production was regained.

Stoves and Fireplaces

A section of the works which expanded during the second half of the century was that devoted to the design and manufacture of stoves and fireplaces. On the ornamental side, Maurice B. Adams and Alfred Stevens were brought in as designers and they produced many varied and

elaborate groups—fireplace, fender and overmantel—described in the catalogues as *en suite*, including designs in the style of the Adam Brothers and Chippendale as well as Gothic and Classical. Though a great many of their designs are over-elaborate and quite out of today's taste, they were very popular at that time.

Engineering Section Extended

The engineering section rapidly extended, and built a large variety of steam engines and machinery, including the machines and rolls for the forges both in the Dale and at Horsehay. The engine shop was well fitted with large machine tools, among them some of the best of the time, which were capable of the heaviest work; a lathe with a 20-ft. dia. face-plate, and a planing machine to take 20 ft. by 8 ft., were matched by drills, shears, presses and other machines on the same scale. In about 1830 the Company had begun to develop high-pressure pumping engines, though this work was no new venture, for pump barrels had been cast from the time of Abraham I. Some very large installations were made both for mines and for use in canal and harbour work. An important invention was the Parker and Weston Patent Pump, of which the Company was the sole maker. Parker was a moulder, and Weston a machinist in the works. The former was also an inventor and later founded his own firm.

Other Developments

There was an early interest in electrical work, and in the art-casting department the Company used electro-deposition of bronze and copper finishes on a large scale. The Elwell and Parker patent High-Speed engine, running at 500 r.p.m., was built in great numbers, and along with generators, for which most of the castings were made at Coalbrookdale, were used to engine the earliest electric-power generating stations, as well as for small industrial and private plants. Tank locomotives for collieries, ironworks, contractors' plants and works' shunting, continued the Company's long standing interest in the steam locomotive. In the foundries small utility castings still held an important place in production—pots, frying pans and a hundred other smallware articles for the ironmonger were made, along with a rapidly increasing range of rainwater and soil goods—gutters, fall pipes, drain and water-pipes, gratings, etc. About 1886 the Coalbrookdale Company leased and later sold the Horsehay works to the Simpson family, who considerably extended the bridge and engineering side. To-day the Horsehay Company is still making bridges and specializing in the large cranes used in modern steelworks.

Change of Name

In the middle of this expansion, the Company was registered as The Coalbrookdale Company, Limited, its present name. The Company prospered, and at the beginning of the new century employed about 1,100 men in the Dale works. In 1901, to meet new demands, the Severn Foundry was built on the river bank at Dale End and for five years, amongst other work, it developed and produced a group of pioneer gas-cookers, many thousands of which were used by the London County Council in their housing schemes. Rainwater goods, large cooking ranges for hotels and canteens, and furnace and sugar pans for export and architectural castings were also made. This foundry continued to operate until early in 1917, when it was closed down due to the loss of manpower to HM Forces in the 1914-1918 war.

Lower Furnace Pool Filled in

In 1903, to allow a further extension of the Dale works the Lower Furnace, Pool was filled in. All trace of the Lower Furnace of 1715 had gone during the expansion of the engine shops, and now many of the landmarks of the old works in the middle and lower Dale disappeared. The Old Furnace in the upper Dale was buried among and under a mass of moulding-patternmakers' and smiths' shops, but fortunately was left intact and to some extent protected by them. These numerous moulding shops in the Upper Works were only closed in 1930, when the Upper Forge Pool was filled in and new moulding shops of a very modern design were built over the site. W. G. Norris handed over the works to Duncan Sinclair in 1897, but remained in the directorate until about 1910. From 1904 to 1906 B. S. Brockbank was manager, and was followed by W. S. Malcolm who remained until 1929, although

Art castings on show in the museum.

Alfred Darby II was chairman of the Company from 1886 to 1925, and his retirement marked the end of the Darby connection with the Works.

1914 TO 1928

With the outbreak of war the course of normal work was diverted. The production of gates and railings terminated in 1915, and the engineering department was leased to The Liverpool Refrigeration Company, who retained it until 1929. Aerial bombs, hand grenades, gun-carriage brake-blocks and many types of light-engineering castings were the principal manufactures during the war years, but on the cessation of hostilities the Company turned its attention to the development of the " Servall " Oven-over-fire Combination Grate, over 100,000 of which were produced, a large proportion of these being taken by the London County Council. In 1922, many companies were feeling the strain of world conditions and "nationalization" was the new watchword for industry. The Coalbrookdale Company responded by forming, with the Planet Foundry Company, Limited, Guide Bridge, Manchester, M. Cockburn & Company, Limited, and McDowall Steven & Company, Limited, both of Falkirk, an allied group under the title of Light Castings, Limited. The four constituent companies continued to produce their own specialities but shared matters of major policy and sales organization. The years 1923 to 1928 were a period of active development of all the lower works area in Coalbrookdale, with a great increase in the output of rainwater goods and the mechanization of garden-roller production. The brickyards were active at Shutfield and Lightmoor, and clay was still mined at Cherry Tree Hill, although bricks were not made there after 1905. The Company made all the firebrick shapes for their solid-fuel appliances, and for outside sale produced firebrick goods and roofing tiles, making as many as 125,000 tiles a week as their contribution to the local authority housing schemes.

NEW PARTNERSHIP

In 1929 The Coalbrookdale Company became a subsidiary of Allied Ironfounders, Limited, but like all the other constituent companies, on its working side it retained its autonomy and its peculiar character. In 1930 a great remodelling was undertaken, starting with the closing down of the Upper Works moulding shops and the filling in of the Upper Forge Pool. A central gas-plant with electric generators, which was started in 1906, was closed down and the whole works turned over to a public electricity supply. Coalbrookdale added to its long list of " firsts " by designing and installing the first completely-mechanical moulding and sand-conditioning plant in the country, on which a large variety of castings could be produced with a greatly increased output. The engineering department was taken back from Liverpool Refrigeration Company, Limited, and became a plant maintenance and production unit for Allied Ironfounders, making and maintaining the patterns for the Ketley Pipe Plant. In 1938 the road down Coalbrookdale was improved at the Upper Forge, and in the alteration of its line a direct link with Abraham Darby I was severed.

WORLD WAR II AND AFTER

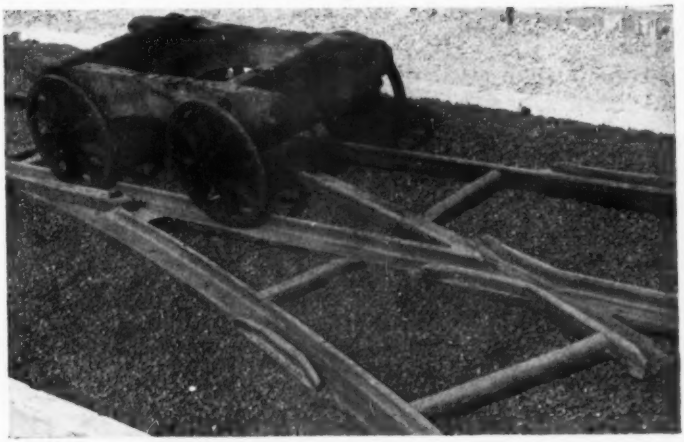
The war of 1939-45 again imposed new tasks on Coalbrookdale, and in spite of its older Quaker tradition the Company had to take up the production of bombs and other war materials. However, with the end of hostilities, thoughts and energies were directed to the problems of peace, and in 1944 the Company was able to produce a series of solid-fuel appliances, including the " Post-war Cookers " of revolutionary design. The enormous development of this type of appliance in recent years is another example of the many pioneering discoveries and designs made in Coalbrookdale. Further work on the cookers produced the " Rayburn," of which more than 150,000 have been made at Coalbrookdale at rates varying between 300 and 500 a week. A mechanized moulding plant was designed and installed for the production of the large castings required for the " Rayburn " Cooker, and this came into operation in 1947 as part of the No. 2 Mechanical Plant. In the post-war housing and rehousing programmes Coalbrookdale have played a large part, producing about 10 per cent. of the country's solid-fuel appliances for domestic use

Abraham Darby Celebrations

Sir Frederick Scopes and his committee who organized the three-day celebration of the 250th anniversary of the use of coke in the smelting and remelting of iron deserve warm congratulations on the outstanding success of their efforts. At the imposing banquet, there were gathered together, in not vastly different proportions, the important personages of the foundry, iron and steel, and coke industries, probably for the first time since their technical " divorce " some 50 years ago.

The opening lecture by Professor T. S. Ashton was fascinating as it revealed the background to Darby's invention and industrial development of the period, which in fact precluded large-scale enterprise, being dependent largely upon water power and sketchy inland, land and water transport. Dudley's claim to have used coke was discounted by the fact that the type of coal specified was not of the coking variety. Darby had the ill luck to start up his furnace during the worst winter in this country's recorded history, when frost lasted until June! The lectures given on the second day of the celebrations exhibited great erudition and also made outstanding contributions to the recording of UK industrial and economic history.

The final day was devoted to a whole-day visit to the Coalbrookdale indoor and outdoor museum, the Iron Bridge, an aqueduct and a skid for transferring barges from canal to river. Allied Ironfounders deserve the thanks of everybody interested in the history of founding, for they have erected and made available to the general public, for all time, a unique display. There is the old furnace (dating from 1709), in an excellent state of preservation, because it has been covered with debris for generations. The picturesque site is embellished by a Cupid-and-swan fountain, which was first erected in Hyde Park for the 1851 Exhibition. It was acquired by the Corporation of Wolverhampton and once adorned a local park, but was finally banished to the obscurity of a



Old-time truck and cast-iron rails, the first of which were made in 1767.

storeroom. As a gift from Wolverhampton, it has now found a final resting place in ideal surroundings. The entrance to the excavated site is through gates, recently cast and suitably inscribed to commemorate the opening and that of the works, 250 years ago.

The two rooms of the spacious museum combine in a superb way to disclose by exhibits, paintings and documents, the development of ironfounding and the history of the Darby family.

DINNER

The dinner held to celebrate the 250th year of coke in ironmaking was held at the Grand Hotel Birmingham on Thursday, September 24, and attracted an attendance of about 300. It was presided over by Sir Frederick Scopes and with him at the high table were the Rt. Hon. the Lord Mills, P.C., K.B.E., Minister of Power; Mr. C. R. Wheeler, C.B.E.; the Rt. Hon. the Lord Bridgeman, K.B.E., C.B., D.S.O., M.C., H.M. Lieutenant of the County of Salop; Mr. G. Savile Steven, managing director, Allied Ironfounders, Limited; the Lord Mayor and Lady Mayoress of Birmingham and Professor G. W. H. Lampe, vice-principal, University of Birmingham. Other prominent guests were Mr. Basil Darby and members of the Darby family; Mr. E. J. Leaver (Carron Company); Mr. G. W. Ilsley, the Master of the Worshipful Company of Founders, and Mr. A. H. A. Wynn (National Coal Board).

Copper Coalbrookdale tokens, made when there was a shortage of Mint coins. One of these tokens was presented to Lord Mills at the anniversary dinner.

Gas Porosity in Aluminium Alloys*

Ways of reducing porosity in aluminium-alloy castings are set out. Small voids in a casting often affect the tensile strength, wear resistance and pressure tightness. Much production time and money may be saved by attention to several basic rules of foundry practice.

Gas porosity in aluminium-alloy castings can be controlled. Hydrogen is the gas mainly involved, and the principal source of this gas is moisture. The foundryman should be aware of the sources of this gas, and the methods whereby its absorption may be avoided or minimized.

Causes and Cures

Steam from Combustion: Products of combustion in fuel-fired furnaces may generate water in the form of steam, necessitating proper firing techniques. Electric furnaces have the advantage of avoiding gas absorption by molten metal from this source.

* Abstracted from an article in *Aluminium News.*

Atmospheric Moisture: Atmospheric moisture varies from a fraction of a grain per cub. ft. of air, to 12 or 13 grains in hot, humid atmospheres. Extensive exposure of the melt may cause gas absorption.

Entrapped H_2 in Ingots: Hydrogen may be present in the metal. When alloy pig or ingot is cast, there may be some dissolved gas in the molten metal, precipitated during solidification and trapped in the form of pinholes. Such hydrogen is in the molecular form (H_2) and is not readily re-absorbed by the melt during remelting, generally escaping to the atmosphere when the alloy is melted.

Metal-surface Gases: The surface of ingot and scrap metal may hold gases which remain during

remelting. Gases on aluminium surfaces occur in the form of physically-held absorbed films, activated chemisorbed films, and reaction of corrosion products. The first of these films is readily removed by heating, but the second, and even the volatile portions of the third, may be removed by prolonged heating at melting point. This latter form of gas absorption can be minimized by avoiding corrosion of the charge material. A short storage time, using a dry place, is recommended. Gas absorption from this source is also minimized by pre-heating the ingot and scrap, by adding them to the furnace on top of the charge as it melts down.

Moisture on Metal Tools: The surfaces of cold metal tools such as skimmers and thermocouples may contain a small amount of moisture, especially if these tools have flux adhering to them. This may be avoided by preheating the tools before use. Preheating of metal tools in a gas or oil flame can, however, cause disadvantages, because condensation of moisture may be created by the flame on the cold tool.

Damp Refractory Materials: New furnace-linings and new crucibles should be heated slowly to a red heat, and held at this temperature for some time, before the metal charge is added. Moisture occurs within the refractory, so considerable time at a high temperature is required to remove this gas.

Hydrogen pick-up during Pouring: During the pour, when the oxide of the molten metal is broken, the absorption of hydrogen can be extremely rapid. Careful handling of the metal from the holding furnace to the pouring ladles, and from the ladles to the mould, is essential to avoid excessive gas absorption from the atmosphere.

Damp Moulds: Moulds also contain moisture, some of which is evolved during the pouring operation. Any excessive turbulence in the gating system and low sand permeability, which causes the gas, mainly steam, to penetrate the oxide surface and bubble into the melt, will accentuate gas absorption. Therefore it is important to control the moisture of the foundry sand, and to use sand having adequate permeability.

The following precautions will help to minimize gas absorption during and after the pour:

(*a*) Avoid excessive contact of the melt with the atmosphere; (*b*) hold the ladle as close as possible to the mould cavity to minimize the height of drop from the ladle; (*c*) pour rapidly from one container to the other down an inclined suface and minimize turbulence; (*d*) use a sand of controlled moisture content and adequate permeability to avoid the penetration of generated steam into the melt in the mould cavity, particularly in large sections, and (*e*) avoid excessive skimming.

Degassing by Fluxing

Degassing may be accomplished by introducing a gas or vapour, usually chlorine, nitrogen or volatile halide, into the bottom of the melt so that the bubbles rise upward. As the gas or vapour bubble is not saturated in respect of hydrogen, some of the hydrogen in the melt diffuses into the bubble and escapes as it is carried with it to the surface. Dry helium, argon or nitrogen may be used for this operation, but chlorine is most frequently used. It is essential that fluxing material be free from moisture. It is possible to de-gas by using dry, solid volatile halides containing grain-refining elements (such as certain compounds of titanium, boron, and zirconium) to produce a combination effect of grain-refinement and degassing.

Solidification and Remelting

Gas in a melt that solidifies in a crucible is either evolved from the melt surface, or trapped in the metal to form pinholes. Such entrapped gas will then be in the form of molecular hydrogen (H_2), and will not be readily re-absorbed during remelting. Although this procedure is less efficient, it will tend to minimize the absorption of gas derived from the surface of the charge material, although none of the other sources of gas are eliminated by this technique.

South Wales Ports Trade

Once again improved imports have tipped the scales in favour of trade through South Wales ports compared with a year ago. For the four weeks ended September 6, the total trade was 1,249,524 tons, compared with 1,206,975 tons in the corresponding period last year. Imports, at 773,017 tons, were 55,000 tons up on last year; exports, at 476,507 tons, were about 12,000 tons down.

So far this year total trade of the ports has amounted to 11,387,152 tons, 203,713 tons less than the comparable 1958 figure. Imports have been up—7,196,471 (6,717,302) tons. Iron ore, at 2,750,983 tons, was 281,523 tons above the 1958 level and non-ferrous ores have risen by 9,667 tons to 171,962 tons. Imports of iron and steel goods fell by 131,601 tons to 104,176 tons.

The biggest decline in exports—4,190,681 (4,873,563) tons—has again been in coal, coke, and patent fuel. Foreign shipments have dropped from 1,129,843 tons to 765,606 tons. Shipments of tinplate, however, have showed an improvement of no less than 65,560 tons to 317,816 tons and iron and steel manufactures were up by 109,525 tons to 368,911 tons.

The 1959 tonnages through the seven ports (1958 figures in parentheses) for the year to September 6 are as follow:—Newport, 1,559,751 (1,766,687) tons; Cardiff, 1,553,324 (1,370,151) tons; Barry, 887,624 (1,231,659) tons; Port Talbot, 1,896927 (1,640,597) tons; Swansea, 5,189,429 (5,248,946) tons; Penarth, 282,600 (304,461) tons; Lydney, 17,497 (28,364) tons.

Non-sparking Safety Tools. In a 16-page brochure neatly illustrated with line drawings, Charles Carr, Limited, Grove Lane, Smethwick, 40, Birmingham, have described and priced a wide range of hand tools, made from aluminium-bronze, which exhaustive tests have shown to be completely non-sparking in use.

ISI Translations

From amongst the most recently published lists of translations available from the Iron & Steel Institute (4, Grosvenor Gardens, London, S.W.1), the following have been selected as being of interest to founders. The price quoted is that for single copies, postage extra, there being reductions for quantities ordered. Readers writing for translations, or for further information, should mention this JOURNAL when doing so.

1369 INVESTIGATIONS OF CONVERTER BOTTOMS. Kohler, W., *et al. Stahl u. Eisen*, 1959, May 14, pp. 674-683. (£6 5s.) *Summary:* Practice at the new dolomite plant of the August Thyssen-Hütte A.G., Duisburg-Hamborn. Vibration of converter bottoms through a vibrator plate located above. Composition of unfired and fired converter bottoms. Types of carbon in fired bottom. Operating conditions of converter and their influence upon bottom life. Influence of packing between bottom and lining. Effect of blowing on bottom life. Relationship between quality of steel and bottom wear. Economic efficiency.

664 DESULPHURIZATION IN BASIC-BESSEMER STEEL-WORKS. Decker, A. *Rev. Univ. Mines*, 1957, May, pp. 165-212. (£10 text only, £1 for 38 illus.)

1100 INFLUENCE OF INDUCTION HEATING ON THE AUSTENITIC GRAIN OF CARBON STEELS. (Summary.) Kidin, I. N. *Metallov. Obra. Met.*, 1956 (1), pp. 40-41. (£1.)

Translations in course of preparation include:

1434 PHYSICO-CHEMICAL BASES OF DESULPHURIZATION IN THE BASIC OPEN-HEARTH FURNACE. Speith, K. G., *et al. Stahl u. Eisen*, 1959, June 25, pp. 926-933.

1437 METALLOGRAPHIC ANALYSIS AND ITS APPLICATION TO STEEL. Heiskanen, S. *Jernkont. Ann.*, 1955 (2), pp. 78-132.

The initials HB, etc., stand for the organization to which enquiries for translations should be made, quoting the reference numbers. Enquiries should not be addressed to the Institute. Addresses are quoted at the end of this item.

DSIR M 462 Bogoslovskii, Yu. V. AN ULTRASONIC FLAW-DETECTOR. *Moscow Mashgiz*, 1957.

HB 3884 Fal'kova, O. B. DETERMINATION OF OXYGEN IN STEEL BY A SPECTROSCOPIC METHOD. *Izv. Akad. Nauk SSSR.* Ser. Fiz. 1955, 19 (2), pp. 149-50.

HB 3944 Katomin, B. N., *et al.* INVESTIGATION OF CONTINUOUS CASTING BY MEANS OF RADIO-ACTIVE ISOTOPES. *Izv. Akad. Nauk. Otd. Tekh. Nauk*, 1957 (1), pp. 123-35.

DSIR M 499 Lisin, D. M. RELATIONSHIP BETWEEN THE COKING PERIOD AND THE WIDTH OF THE FURNACE CHAMBER. *Koks i Khim.* 1958 (12), pp. 18-21.

DSIR RTS 1063 Vargaftik, N. B., and O. N. Oleshchuk. THERMAL CONDUCTIVITY OF SLAGS IN THE SOLID AND MOLTEN STATES. *Teploenergetika*, 1958 (12), 79-85. 15s.

Symbols for sources of translations:—

DSIR: Department of Scientific and Industrial Research, 20, Chester Terrace, London, W.1. HB: Herbert Brutcher, P.O. Box 157, Altadena, California, USA.

Tungsten-ore Sales

The Board of Trade has instructed its agents, British Tungsten, Limited, to resume sales of a limited quantity of tungsten ores as market conditions permit. Sales will be made gradually in the United Kingdom and abroad so as to avoid disturbance of the market.

No sales have been made from the board's stocks since June, 1957, in view of the weakness of the market. However, prices have risen sharply in the past few weeks, and now stand at about 167s. a unit. The Board states that no fixed period has been set for the disposal, nor has any specific quantity been set aside for this purpose.

High-temperature Equipment Exhibitions

Morgan Crucible Company, Limited, Wandsworth Works, Point Pleasant, London, S.W.18, is co-operating with the Merseyside and North Wales Electricity Board and the North Western Electricity Board in giving practical demonstrations of electricity as a heat-source for industry. Two exhibitions have been arranged, the first of which is to be held at the Industrial Development Centre, Paradise Street, Liverpool, from October 12 to 20, and the second at the Main Electricity Board show-rooms, Town Hall Extension, Manchester, from October 26 to 30; both exhibitions will be open from 9.30 a.m. to 5.30 p.m. daily.

A number of high-temperature furnaces illustrating the versatility of Morgan's Crusilite furnace-heating elements will be operating at temperature throughout the exhibitions. The complete range of elements now available, associated refractory materials, as well as experimental mock-up furnaces will also be displayed. Technical staff will be in attendance for discussion on any aspect of heat-treatment in which Crusilite may be of value.

Industry's Capital Spending

Company forecasts of capital expenditure made at the end of 1958 proved too pessimistic, according to Board of Trade estimates published on September 18. Industry is likely to spend a little more on capital equipment this year than last, but next year the amount will probably be slightly less. Manufacturing companies will spend about 10 per cent. less this year and there may be a further drop of 5 per cent. next year. The decline will be entirely in plant, machinery, and vehicles, which may drop by 10 per cent., and rather more money is likely to be spent on building work than in 1959.

Industry's capital spending in the second quarter was about the same as in the second quarter of 1958, but the proportions showed a big variation. Manufacturing industry spent about 10 per cent. less, while other industries and services spent 14 per cent. more. Within manufacturing industry, 13 per cent. less was spent on building work and 12 per cent. less on plant and machinery, while 15 per cent. more was spent on vehicles.

Birmingham Re-development Schemes

The first of a new series of special surveys into the problems of West Midland market towns seeking new industry from the Birmingham overspill, was initiated on September 21, when 12 members of the Birmingham area committee of the National Union of Manufacturers, led by Mr. F. C. Shelley, acting chairman of the committee, paid a one-day visit to Ludlow. Here discussions were held with members of Ludlow Town Council, the chairman of Ludlow Chamber of Commerce, Mr. C. E. Judd, Mr. A. J. Hall of the West Midland Industrial Development Associations, and representatives of schools. Other places to be visited are Worcester and Wem in Shropshire.

The reports made by the committee are to be sent to the information library of the NUM in Birmingham, where they will be available for manufacturers seeking data about transfers which may become necessary under the Birmingham redevelopment schemes.

Equipment & Supplies

Core Oil

F. & M. Supplies, Limited, 4 Broad Street Place, London, E.C.2, showed for the first time at the recent Foundry Exhibition in Bingley Hall, Birmingham, a new core oil, designated Supinol RB.314. It is claimed that its development is the result of research into new methods of formulating and compounding core binders, involving: the study of developments in foundry practice over the past 15 years, and the economics of coremaking from the foundryman's point of view; scientific re-evaluation of the conventional raw materials used in the manufacture of core oils and other binders, and a search for new raw materials.

Steep Dry-strength Curve

The important feature stressed for the new oil is the fact that the major part of its dry strength is due to polymerization, which occurs very rapidly at the baking temperature, and not, as is usually the case with conventional oils, to a gradual rise in strength due to oxidation. In practice this means that, using the new material, the bond is formed as soon as the core reaches baking temperature and, expressed graphically, the dry-strength curve is very steep. Typical cores produced are illustrated in Fig. 1. The danger of overbaking has been overcome by blending oxidizing oils into the finished product. The greatest benefit will be gained from using the new core-oil when one or more of the following conditions apply: cores have to be baked quickly; cores have to be baked uniformly throughout; reduction in gas evolution is essential, and dry permeability is called for.

Low Specific Gravity

Supinol has a lower specific gravity than raw linseed oil, and therefore makes more gallons per ton, a fact that should be taken into consideration when comparing prices. It also has a very low viscosity, which ensures easy measuring by volume and excellent mixing with any type of sand—it is easily emulsified with any foundry cereal and water. When using it, any normal core-sand mixer is suitable—sand may be either wet or dry. The recommended percentage of oil to be used is 0.5-1.5 per cent. Any normal batch or continuous stove is suitable when baking—the temperature range should be 350 to 500 deg. F.

Advantages

Advantages claimed for Supinol are: baking time reduced by 30 to 50 per cent.; stoving capacity increased; fuel costs reduced; higher dry strength than linseed oil at shorter baking cycles; easy mixing in sand mill; good skin finish to cores; economical in use—more gallons per ton; excellent stripping properties from corebox; less gas evolved on pouring; good bench life of core sand; cores uniformly baked, and less fumes on casting.

FIG. 1.—*Examples of medium-size mating cores produced with a rapid-drying corebinder introduced by F. & M. Supplies, Limited, of London.*

Maintenance Scheme

Wolf Electric Tools, Limited, Hanger Lane, London, W.5, have introduced a maintenance service for the benefit of all users of their equipment in Great Britain and Ireland. Under this scheme a maintenance service contract is offered (covering two, three or four overhauls per year) which includes dismantling, cleaning, thorough mechanical and electrical overhaul, lubricating, renewal of carbon brushes and skimming of commutators if necessary.

Heavy-duty Tractor

David Brown Construction Equipment, Limited, Hanworth Park, Feltham, Middlesex, are marketing a heavy-duty industrial tractor (model 900). In the illustration (left) one of these tractors (which is also equipped for shunting rolling stock) is being used, at the Birkenhead works of Manganese Bronze and Brass Company, Limited, to haul a 50-ton ship's propeller from the foundry to the machine-shop.

Section devoted to the technology of producing
DIMENSIONALLY ACCURATE CASTINGS

Investment Castings..... some Aspects of their Costs*

By W. S. Fowkes

Development of the investment-casting industry, and the impetus given to its expansion by the needs of the aero industry is first dealt with. Then, the present position is considered and the need for rapid expansion emphasized. The article concludes with a description of a costing system, the adoption of which the Author regards as essential if the industry is to make progress on sound basic economic lines.

DEVELOPMENT OF INVESTMENT CASTING

The establishment and early expansion in the 1940's of investment casting in this country was largely dictated by the requirements of the aero industry, upon the successful development and introduction of gas-turbine-powered aircraft. Here was a ready-made market for the products of investment foundries and, although in most cases the aero-engine manufacturers themselves installed investment-casting facilities, requirements soon outstripped output capacity, with the result that the aero industry began to seek assistance from outside sources. This help was forthcoming from the independent investment caster who, having already realized the industrial potential of the process, had himself created facilities for investment casting.

Three Types of Firm

The sequel to these events was the emergence of three distinct categories of operating firm:

(1) The tied foundry of the aero-engine manufacturer.

(2) The tied foundry of the independent organization—in many cases the parent firm being already well established in the field of steel and/or conventional founding—where the operation of the new process could be considered as merely an extension of normal manufacturing activities.

(3) The independent investment caster, where the whole of the Company resources was devoted to the manufacture of investment castings.

That section of the independent investment-casting industry comprising foundries in categories (2) and (3), engaged in the manufacture of jet-engine parts, enjoyed extremely favourable marketing conditions, as the need for a high level of output often overshadowed selling-price negotiations (upon which the aero industry would normally have insisted). Again, certain castings (stator blading, for example) cast in high-temperature alloys could not be made satisfactorily on a production basis by other methods of manufacture.

Unjustifiably-high Prices

The demand for investment castings during this period and into the early 1950's greatly exceeded the supply, the position being further aggravated by heavy and increasing national defence requirements. The customer (in this case the aero industry) called upon its outside castings suppliers for unlimited production and, as so often happens in such circumstances, with an almost complete disregard of the prices that it would have to pay for the castings. Thus, as was to be expected, unjustifiably high prices were paid in many instances. This was partly due to inefficient production giving rise to a very poor "saleable output: total production" ratio, in respect of which the extenuating circumstance of a too-rapidly expanding industry in relation to the acquisition of technical knowledge may reasonably be claimed, but also due in considerable measure to unrealistic costing procedures employed by some firms.

Recent Decline in Demand

As is well known, this so-called ready-made market is rapidly contracting, due to the advent of ballistic missiles, rockets and the like, and there are no signs of the development of an equally large and advantageous outlet for investment castings. Strenuous efforts must be made, therefore, by those investment casters who have to a lesser or greater extent served the aero industry, to compete successfully from both quality and price

* A further instalment of the series of papers presented during the first annual conference of the British Investment Casters' Technical Association (held at Connaught Rooms, London, on May 11 and 12). The Author is on the staff of H. & F. Precise Castings (1959), Limited.

aspects) with conventional methods of manufacture and, possibly also of great significance, with other types of close-tolerance casting. Those foundries which have not been involved in the aero-engine business, and which have employed the process solely on commercial as distinct from aero work, will have to contend with additional competition from those lately engaged in producing aero castings.

PRESENT POSITION

Rapid Expansion is Necessary

Having briefly examined the build-up of investment casting, and the impetus given to its expansion by the needs of the aero industry, and having observed the recent rapid decline in that industry's requirements, the answer to the question as to the future of investment casting in this country must be sought. As already pointed out, the aero industry offers no solution; indeed, with the almost urgent necessity for that industry to broaden the scope of its own manufacturing activities, added competition in the commercial field may well have to be met from the tied foundries of the aero-engine manufacturers themselves. The only answer lies in the rapid expansion of work from other industrial and commercial sources.

Break-through must be achieved

Generally speaking, apart from the aero-engine manufacturers' own foundries (and perhaps a few other exceptions), the investment-casting industry is, by nature, almost wholly sub-contracting. Its survival depends, therefore, on its ability to sell its products in the face of competition from sources manufacturing by alternative or more conventional methods. In many cases, these other sources have been supplying the same industrial and commercial users for many years, and have established traditional markets. It is in these markets that investment castings must achieve a break-through, by employing such factors as:

(*a*) Improved design of components—for example, integrally-cast parts to displace fabricated and welded assemblies.

(*b*) Casting parts as near to finished sizes as possible to reduce or, in some cases, to eliminate, expensive machining operations—to replace parts which have formerly been machined from bar stock or from forgings.

(*c*) Planned collective publicity, which in the opinion of the author would go far in persuading those responsible for the design and functioning requirements of components to at least investigate the merits of investment castings.

(*d*) Fair selling prices based on real costs.

The tasks of convincing designers and engineers of the great advantages that investment castings possess over parts manufactured by other methods, and of carrying out the progressive development of process techniques, lie in the hands of technical sales and publicity department staffs, works chemists, and metallurgists. Notwithstanding any success that may attend their efforts, unless a sound costing and estimating policy is maintained, failure to gain these markets is assured.

Initial Successes

Fortunately, there is evidence that considerable success in "selling the process" to designers and engineers is being achieved, and as this expansion in knowledge of the process and its products manifests itself over the whole range of components suitable for manufacture by investment casting, so will the good intentions of the industry as a whole be put on trial by the markets it seeks to serve. However, should those markets find cause to suspect the industry of indulging in sharp practices, then the investment-casting industry will not mature, nor find a permanent place in the pattern of the country's industrial make-up, despite its attaining an abundance of scientific and technical accomplishments.

"Sharp Practices"

Sharp practices may be exemplified by the following typical case in point, and have been knowingly employed despite their damaging effect on the industry from the long-term viewpoint.

Over-charging

A part which had formerly been manufactured satisfactorily by conventional methods became the subject of an enquiry for production as an investment casting. The part was eminently suitable for production as an investment casting, from both design and alloy castability aspects, and the estimates showed that it could be sold at about 50 per cent. of the price then being presently paid by the enquirer for the conventionally-produced part. The investment caster realized this, but nevertheless entered his quotation for the part at a price far higher than the one he had calculated as the economic selling price, although marginally less than that being paid for the conventionally-produced part (sufficiently less to induce the enquirer to place an order for castings).

Price-cutting

Another example of sharp practice, observed during the general industrial recession which has been experienced in recent months, is the employment of the price-cutting device. This entails castings being offered at below manufacturing-cost prices (in some cases less than the cost of raw materials and labour without any addition whatever for overheads), simply for the purpose of keeping the foundry operating at a certain level of production, regardless of selling castings at a loss. Usually, this type of action can be undertaken only by the tied foundry of the larger organization, in view of the subsidizing which is required by the pursuance of such a policy.

Sooner or later such practices can only bring the industry into disrepute, and should be shunned by every investment caster as being contrary in all respects to the best interests of the industry. Selling prices must be kept strictly in relation to factual costs if the industry is to obtain the high status in the manufacturing world which it desires.

Suppliers must share Responsibility

Suppliers of raw materials to the industry must also share the responsibility for creating and expanding the markets for investment castings, in so far as the prices of their products should be based strictly on costs of production, and undue advantage not taken of the fact that they are quite often operating in a non-competitive market. Continuous efforts must be made by the investment-casting industry to reduce prime costs, and unless suppliers co-operate, by keeping prices of raw materials as low as possible, they are creating an impediment to the expansion of investment casting which is eventually detrimental to the interest of the suppliers themselves.

Accurate Costing is Essential

An attempt has been made in this paper to place before the industry a policy which, in the author's opinion, it must adopt if it is to maintain and expand its present markets and attract new consumers. Provided undesirable practices such as those mentioned are carefully avoided, and provided that sound castings are produced by efficient methods for sale at realistic prices to the buyer, then there is no doubt that the industry will prosper. It has been seen that a pre-requisite to the successful carrying out of the policy advocated is the ability of the industry to accurately calculate its costs. Since nowadays, in almost every instance, firm prices have to be quoted to the intending buyer before orders are secured, it is imperative that the system in operation permits of accurate estimate of manufacturing costs in advance of any production which may subsequently take place. It might be said in this connection that the independent, self-contained, investment casters have a distinct advantage over the tied foundries, in that an entirely suitable system can be installed which, apart from disclosing true costs, also proves them by enabling overall reconciliation of cost accounts with financial accounts. Tied foundries do not always enjoy this flexibility, and it is quite common to find them compelled to cost their products within the framework of a system which, although usually quite valid for machining, fitting and other manufacturing departments, is not in the least adequate for determining the costs of investment castings.

While it is not the author's wish to appear dogmatic regarding systems, nor to seek to impose specific costing procedures on the industry, and although it is acknowledged that there may be alternative methods of arriving at the desired results, it is nevertheless essential that certain basic principles be observed to ensure that true production costs are disclosed.

How much for a Saleable Casting?

Irrespective of the system employed, it must, for every part manufactured, provide the answer to the question, "How much does it cost to produce a saleable casting?" The operative word here is "saleable," since, as every investment caster knows so well, the burden of process scrap has to be supported by the good output. It is necessary, therefore, to be able to determine the cost of the scrap arising at each stage of production. This calls for a form of progressive process-costing system where each departmental cost account is charged with the cumulative cost of production to date, together with the production costs arising in the department concerned, the same account being credited upon the castings moving to the next stage of production. It is important that the number of parts represented by these cumulative costs be recorded in the account, to enable an equal share of the cost of scrap to be borne by each good part produced. In this manner the cost of scrap becomes an addition to the cost of a good part forwarded to the next stage of production.

TYPICAL COSTING SYSTEM

A typical departmental cost account for, say, three separate parts (simplified to illustrate the point) would be as shown in Table 1. From this example will be seen the object in establishing the true cost of scrap or wastage at the stage where it occurs. It will be observed that opening and closing "work in progress" quantities

TABLE 1.—*Example of a Typical Departmental Process Account.*

—	Product A.		Product B.		Product C.		—	Product A.		Product B.		Product C.	
	Qty.	£	Qty.	£	Qty.	£		Qty.	£	Qty.	£	Qty.	£
Cost received from previous process department in the period	908	1,439.3969	675	974.9219	2,206	3,489.9815	Scrapped during the period ..	*45*	*96.9492*	*4*	*8.1815*	*118*	*253.7145*
Cost of production in the period:—													
Materials ..		49.3736		38.3890		119.4578							
Labour ..		136.2250		105.9177		329.5919	Work in progress at end of period	71	161.1044	—	—	94	213.6267
Power		66.6660		51.8342		161.2962							
Overheads ..		266.5515		207.2492		644.9125							
Total ..	908	1,958.2130	675	1,378.3120	2,206	4,745.2399							
Work in progress brought forward from previous period	74	157.4334	1	1.9547	87	184.9912	Transfers to next process department	866	1,954.5420	672	1,380.2667	2,081	4,716.6044
Total ..	982	2,115.6464	676	1,380.2667	2,293	4,930.2311		982	2,115.6464	676	1,380.2667	2,293	4,930.2311

and their respective values are determined automatically, thus providing accurate and indispensable information for the preparation of financial accounts. It should also not be overlooked that this type of cost account contains information which provides valuable data on operating efficiency, pinpointing improvements or deteriorations in standards of work (and sometimes in materials) for the benefit of those responsible for process control.

Allocation of Charges

Having established that this type of system will, in principle, determine the stage-by-stage cost of each good casting produced, it must be decided how to allocate and charge the various items of costs, departmentally. As in most industries, investment-casting costs consist of direct and indirect expenses. Direct costs are incurred for materials used in the process, and for labour which is specifically allocable to the working of these direct materials. Indirect costs, or overheads, are those which by their nature cannot be allocated to individual products, and which require a basis for their distribution over the whole range of production. The allocation of materials does not present a very difficult problem as, generally, they are all special-purpose materials. Some recommendations, however, should be made as to their treatment. It is of the greatest importance that they should be charged direct to production wherever possible.

Sectionalized Stock Ledger

The stock ledger, or whichever form of stock control is operated, should be sectionalized under process departments (preferably in process sequence) thus allowing easy posting to the departmental cost accounts. Where materials are used in more than one department, the cost journal is the medium for transferring the amount involved from the stock-holding account to the using account. If well-designed, the stock ledger provides a wealth of information, including daily balances of stocks on hand, quantities outstanding against orders, and price movements—it also provides the means for reconciling "commencing stocks plus materials received" with "issues during the period plus remaining stocks."

Labour

The allocation of labour is also a relatively simple matter, and merely requires a suitably-designed form of payroll, along with accurate information from each department regarding quantities processed, and times taken to carry out operations where required for purposes of calculating bonus payments. Once again, the principle of charging direct to production should be strictly observed. For example, having decided the number of labourers necessary to sustain a production department at a given level of activity, there is no reason why their cost should not be charged direct to production.

Power

Since power, usually in the forms of gas and electricity, accounts for an appreciable proportion of the cost of an investment casting, it is quite proper to charge these items direct to production. Gas, it is suggested, should be charged on the basis of the number of moulds fired, and electricity on the number of melts poured.

Overheads

Having discussed materials, labour and power, and emphasized that as little as possible of these elements of costs should be left for recovery as overheads, overheads themselves and their recovery must be considered. Overheads may be divided into three main classes, variable, semi-variable and fixed, when expressed in relation to direct labour. Variables are those which fluctuate in the same ratio as direct labour, for example, works non-productive labour (when this is not allocable direct to production). Semi-variables fluctuate only to some extent with movements in direct labour, and are typified by such items as maintenance costs and certain insurances. Fixed overheads, as their name implies, remain unchangeable regardless of the level of production—examples of these are rent and rates, and advertising and publicity (if it has been decided to spend a specific sum for these purposes over a fixed period.)

Installing the System

In considering the setting up of a system along the lines indicated, an examination of past financial accounts should reveal the total overheads which had to be borne by the total saleable output over the period of those accounts. If a satisfactory level of producion had been maintained over that period, and the amounts charged to Profit and Loss Account as overheads were accurate, and provided the accounts showed a reasonable surplus, then at least an average operating efficiency would be implied, and the ability to compete for work successfully, proved. In this case, a definite relationship between the level of production activity and the overheads charged can be seen to exist.

Overhead/Direct-labour Ratio

It is generally acknowledged that spreading or allocating overheads to production may be effectively carried out by determining their relationship with the production factor common to all process departments, *i.e.*, direct labour, and by expressing total overheads as a percentage of total direct labour. Though recognizing that persistent efforts are continually being made to increase the mould yield value by improving designs and reducing process scrap, and that success in these endeavours will further reduce direct costs (thus affecting the overhead/direct-labour ratio), it is nevertheless necessary for the already determined overhead/direct-labour ratio to be utilized for the vital purpose of estimating production costs when enquiries for castings are received, and when quotations are required.

In the absence of a satisfactory trading period on which to establish a realistic overhead/direct-labour percentage, budgets to cover the ensuing financial period should be prepared by determining:

(1) The anticipated level of production, expressed perhaps in terms of mould output, taking into account the total manufacturing capacity available and the minimum economic utilization of equipment—from this the total direct labour for the coming period may be assessed. (2) The estimated total overheads to be recovering during the period. From this information the overhead/direct-labour percentage may be calculated, thus providing the means for accurate estimating for quoting against enquiries. Frequent comparisons between overheads, budgets and financial accounts will indicate the accuracy or otherwise of the budgets, whereupon simple adjustments to the overhead/direct-labour percentage may be made if required. Variations in direct labour from the estimates may also cause adjustments to be made.

Advantages of the System

The adoption of the type of progressive process-costing system described, together with the strict application of the principles recommended in regard to the treatment of direct materials, direct labour, power and overheads, will ensure the promulgation of factual historical costs in addition to establishing a sound basis for estimating.

Other important advantages accruing from the use of the system are:—

(1) Provided that historical cost accounts are extracted for fixed accounting periods of say, four weeks, and are completed as soon as possible after the termination of the accounting period, over- or under-recovery of overheads against the budgeted quotas are at once evident. Normally, if output increases without additions to production facilities, the tendency is for overheads to be over-recovered upon the application of the pre-established overhead/direct-labour percentage, whilst usually the converse is also true, thus signifiving falls and rises in overall costs of production. These fluctuations, in turn, provide up-to-date information for determining the overhead/direct-labour percentage which must be applied in future estimates for castings.

(2) The cost and quantity of process scrap are divulged at the stages where scrap arises, enabling comparisons to be made with allowances for scrap in the estimates. Again, this is another source of useful information to those responsible for the operation of the process.

(3) By charging production directly wherever possible, and by restricting the amount to be recovered by way of overheads to the bare minimum, the error inherent in all methods of overheads recovery is negated to a very great extent.

Inadvisable Departures from the System

Departures from a system such as that described, which offers simple yet well-controlled bases for accurate costing and estimating, are often responsible for invidious comparisons being made between a main producer's manufacturing costs and those of his sub-contractor.

There is, surely, no justification for treating scrap as a fixed proportion of the total overhead/direct-labour percentage and applying this ratio to each and every part produced by the process. Obviously, some castings, by nature of their design and the casting alloy employed, are more prone to scrap than others of less complexity made in alloys of better castability. Inspection standards may also vary considerably from part to part, depending on the quality specified by the customer, and this too can have a very marked effect on scrap rates. It cannot be too strongly emphasized that the cost of scrap should be "built-in" to the cost of a saleable casting, in the manner prescribed, and should not be treated as an overhead to be recovered at the same percentage rate of direct labour for every type of casting produced.

It is regrettable that these criticisms must be levelled chiefly at some of the larger organizations, who wrongly maintain that special-purpose costing systems cannot be introduced for one relatively small department. In cases where these units also employ the services of sub-contractors (who are often dependent entirely on the output of investment castings, and who are compelled to combine efficient production with a sound costing and estimating system in order to exist), comparisons of production costs are futile and should not be attempted.

It has been observed that a tendency exists in some of the larger concerns for certain labour which can quite validly be described as direct (and, therefore, chargeable direct to production, thus attracting a relative portion of overhead) is instead treated as indirect labour and becomes part of the overhead. Since the overhead addition to the cost of the directs is by a predetermined percentage on direct labour, it is evident that in some cases this particular form of labour is completely ignored when costs are being prepared—and again, if the independent sub-contractor is engaged in producing similar products he is inevitably once more the victim of nefarious price comparisons.

CONCLUSION

The purpose of compiling this paper has been to indicate the conditions necessary to attract and retain the confidence of the commercial engineering world in the industry's ability and intention to supply its products at fair and reasonable prices. With this object in view suggestions as to the treatment of the elements of costs have been made, and the broad lines of what is considered to be a sound policy laid down, a policy which must be followed if investment casting is to attain the status of an accepted and respected industry, and if it is not to be generally regarded as being comprised merely of a few individual organizations operating a freak process. It is to be hoped that those operators who are at present inclined to remain aloof in their attitude to the need for the general, commercial and technical advancement of the process will reconsider their position, and engage in the collective effort to secure a permanent future for investment casting, so that a great industry, having been born, may expand and prosper in its own right.

Investment Castings—some Aspects of their Costs

DISCUSSION

The CHAIRMAN (Mr. R. W. N. Danielson, of Deritend Precision Castings, Limited), thanked Mr. Fowkes for presenting an interesting, and in certain cases, provocative paper, and then called on Mr. Humphreys to open the discussion.

MR. W. J. HUMPHREYS (Deritend Precision Castings, Limited), began by saying that it seemed to him that, if the principles outlined by Mr. Fowkes were applied at Deritend's, a large clerical staff would be necessary. For example, 200 to 300 jobs might be going through at any one time, which would entail 10 to 20 pages of foolscap at each stage, and at least a doubling of clerical staff. Furthermore, Mr. Fowkes referred, in the main, to past history, and it would be interesting to learn how he applied this to his estimating system. Mr. Humphreys' third point concerned the effects of variations in capacity utilization on the selling price. If the capacity utilization went up in one accounting period, and down in the next, one might quote uneconomic prices for orders which come in for the next period. Customers did not mind prices going down, but they did not like them to go up, which might well happen on repeat orders.

MR. W. S. FOWKES replied that he had found it quite possible to carry out the work with a relatively small clerical staff, since he believed that most of the work was already being done, but in the wrong channels. Careful selection of the type of information was necessary—a large volume had to come from the shop floor, and if the people on the shop floor were made responsible for providing the information, then it would be forthcoming. Mr. Fowkes said that he did not regard this as a problem at all; his firm had a large number of jobs going through, but the ratio of clerical staff to production and other works staff was still relatively small. Much depended on the system used, and it was important to obtain the relevant information from the shop floor. As regards relating the past history to current and future estimating, Mr. Fowkes system was valid for setting up a system on these lines. For a given production, certain overheads had to be absorbed. If a firm had made a profit in the past, it followed that they had operated fairly successfully. They should know the total direct labour for a given production, and should base their prices accordingly. The employment or non-employment of available capacity was rather a difficult question, Mr. Fowkes continued. In investment casting, as compared with other industries, the saleable output or turnover was rather high, in terms of return on capital, in relation to the cost of capital equipment. Therefore, the problem was not as serious as in other industries. Employing the available facilities, one must aim at a level of production which would give a reasonable profit margin. It was not suggested that one should put up prices if one was under-employed at any one time. This practice was immoral, and became an impossibility when

(*Continued in column 2*)

Introducing the Author. . .

Mr. W. S. Fowkes is general manager, and a director, of H. & F. Precise Castings, Limited. He was educated at Bemrose School, Derby, and subsequently received commercial training at Derby Technical College, specializing in accountancy, statistics and economics. Commencing employment with Rolls-Royce, Limited in 1935, he underwent comprehensive training in financial and cost accounting. He was promoted to the chief accountant's personal staff in August, 1939, and undertook special statistical duties and budgetary work until joining the Royal Signals in September, 1941, where he served until December 1942. He then rejoined Rolls-Royce as personal assistant to the chief accountant, and was mainly engaged on final accounts, statistical duties, methods and systems until leaving in January, 1946. The next six years were spent in the service of accountants in public practice, in order to gain a wider knowledge of company taxation. He returned to industrial accountancy in 1952 as financial and cost accountant for H. & F. Precise Castings, Limited, and was appointed company secretary in June, 1952, and general manager in December, 1955. Mr. Fowkes is a qualified company accountant, and was appointed to the board of directors of the firm in April, 1959.

one was trying to compete with other people. If bad times were encountered, the industry should accept a lower margin of profit and secure additional work, to occupy plant at the level which gave the optimum return, by means of publicity and other devices.

MR. MERSON (Spartan Steel and Alloys) said that the ratio of overheads in metal in investment foundries was much higher than in conventional foundries, even though the latter were operating on a fluctuating market. The industry was mainly using alloy steels where there was no fluctuation, with a fixed price, and yet the ratio in the cost of metal was higher. In Mr. Merson's opinion, this was because of the relatively small quantities consumed. His experience had been that most investment foundries, even in their buying policy, would do nothing, or very little, to assist by bulk buying. Supposing a three-ton arc furnace was used to turn out metal. Obviously, if it was utilized to full capacity, the metal could be sold cheaper. Investment foundries would buy 10 cwt. or a ton, he said, but would never place an order for 10 tons for delivery as and when required, which order would enable a supplier to go ahead, make it up in bulk, lay it in stock, and charge or invoice after the metal was delivered. No attempt seemed to have been made, he continued, to standardize on specifications. It is surprising that, even within, say, an H.R. Crown Max spec., there were deviations between foundries, so it was a case of making up bits and pieces for one, and bits and pieces for another. This meeting had provided an opportunity to find out why there

was this difference in specifications among a number of investment foundries which were engaged in the same work, and which were using the same alloy for similar castings.

In replying, MR. FOWKES said that suppliers had done a great deal for the industry, but they were in for a tough time with foreign and other competition. However, everything would be all right, he said, provided they related their selling to their cost prices, and did not take advantage of the fact that they were sometimes operating in a non-competitive market. As regards the amount that could be ordered at any one time, it must be realized that investment founding was a sub-contracting industry; inquiries, and orders, for 50 items of one kind, or 100 of another, were constantly being received. Although only 56 lb. of materials might be required, this kind of situation must be accepted if the industry were to expand. Investment founders tried to look as far ahead as possible, and if there was the slightest hope of continuing orders to ask for as much material as was required. The responsibility for differing specifications lay to some extent with the customer who specified the material, Mr. Fowkes continued. It was sometimes possible to persuade him to use an alternative material, perhaps not quite as good, but which was easier to cast. By and large, however, customers knew what they wanted, and insisted on having it. Sometimes a specification within a spec. had to be insisted upon, because process scrap was encountered, and this course was followed when possible.

The CHAIRMAN interposed here to say that the Association was concerned about under-specifications, and a special committee had been formed to investigate specifications, generally.

Cost or Market Value?

MR. D. E. HOPE (Monsanto Chemicals, Limited) said that Mr. Fowkes had referred to a part known to be made fairly expensively—when it was suggested that the part be made as an investment casting, the supplier had been accused of malpractice in estimating his selling cost based on the market value of that part in relation to present costs. Investment foundries received orders for manifold parts, some of which were obviously suited for investment casting. On the other hand, the industry was endeavouring to extend its activities and had to look at very marginal parts. Supposing one took one's yearly output, on the weight of castings, and wanted to make a proper return on that weight of castings, one must presumably take advantage of the maximum profit one can obtain on suitable castings, to balance smaller profits from less suitable castings. With regard to Mr. Fowkes' reference to competition and cut prices—when there was a recession, such as had taken place during the last year, prices tended to come down where competition was encountered, and one either had to lose business or go after it at the lower price. Within a small industry, with much scope for expansion, Mr. Fowkes' comments were eminently sensible. There was no purpose at all in cutting one another's throats, and prices should be maintained at a reasonable level. The same attitude ought to prevail in relation to suppliers, he continued. Take any product, such as binder solution, which might be used in investment casting, and which might be made and sold by a number of world-wide manufacturers—in the European market, for instance, some very keen prices were being quoted, some of them quite unrealistic. The fact that a manufacturer in this country might be competing for that overseas business merely meant that he was meeting the price that existed in any particular country. He was endeavouring, in an exporting country, to meet the competition and the price which prevailed. So the fact that these prices were low on the Continent did not necessarily refer back to the home market prices, which must be realistic. After all, the home market was always open to competition from within the country. Suppliers within the investment industry were actively competing, and prices were competitive, in Mr. Hope's opinion.

In his answer, MR. FOWKES said that he could not agree with Mr. Hope that profit margins ought to some extent be equalized, one part with another. It was most essential that every part should be realistically costed and sold on the basis of its cost. The good ought not to pay for the bad. If this attitude were introduced, someone was eventually going to make the expensive part much cheaper. The meeting did not represent the whole of the close-tolerance industry, and in some cases had found themselves in competition with those outside the Association. There was a danger that the industry here represented would find themselves making only parts that did not pay. Mr. Fowkes said that he could not agree that one ought to have separate differential profit margins on different types of castings—easy ones, marginal ones, or hard ones. There should be a straightforward application as near as could be calculated to the true costs, thus a realistic selling price could be arrived at. Only in that way could a fairly rapid and sizeable expansion of the investment casting industry be attained. Regarding Mr. Hope's point on competing with overseas manufacturers, chiefly those on the Continent, even there the same situation arose if one adopts the suggestion that the good pay for the bad. With goods showing a favourable return in a massive or monopolistic production, where you can get any price, manufacturers were probably doing the same thing in order to break in. The investment industry should, to some extent, resist the pressure from the Continent in respect of raw materials, but being a new industry it had a responsibility to expand. If anybody were suspected of under-cutting with regard to raw materials, then they should be ostracised. Mr. Fowkes concluded by saying that his remarks on suppliers were more in the nature of an exhortation to keep the cost of materials at a level at which the industry could look forward to a steady supply, at prices related to the costs of production, rather than take advantage of monopolistic positions.

MR. HOPE then said that he disagreed very much with Mr. Fowkes's statement about monopolies,

because such a situation could not exist where there was free competition throughout the world.

Replying, MR. FOWKES said that perhaps they disagreed on the term. Investment casters were very loath to change their manufacturing procedures, because they were afraid of running into new forms of scrap, etc. Perhaps it was not a monopoly in intent, but it was certainly a monopoly in effect. It was true of several raw materials the founders used. Perhaps some time the industry would not be able to resist these low raw material prices, particularly if they were related to production costs.

MR. D. H. ARMITAGE (P. I. Castings (Altrincham), Limited) said that the industry was not just interested in making history, but also interested in what it cost. How long, he asked, after the end of an accounting period would Mr. Fowkes consider the publication of accounts satisfactory? Costing was just being wise after the event—the thing that mattered was estimating, and making sure that it was practised in the shop. When one prepared one's estimates did one go through the same form as if one were casting—did one say that one was going to get six wax patterns scrap, and six on coating, and at each stage build up one's scraps in one's estimating? Thirdly, he said, it was very easy to say that the man who charged more than oneself was guilty of sharp practice, and the man who charged less guilty of under-cutting. While investment-founding was only a small industry, there was much specialization, so that anyone inquiring the price of investment casting could get quite a wide price variation without either sharp practices or under-cutting arising.

MR. FOWKES replied that, in spite of the great amount of work involved in presenting cost accounts, four weeks after the end of an accounting period was ample time in which to produce a complete set, reconciled to any financial results that might be available. His own firm operated in four-weekly accounting periods (thirteen in each year) and, after one had closed, they had four weeks in which to produce the cost accounts for the previous period. He continued that he was more concerned with estimating than with costing after the event—one only proved or disproved the other. His firm also took the trouble to compare their historical costs with their built-up estimates at various stages. One was bound to get variations, which one never estimated as scrap or process scrap, and that gave valuable data for future estimates. In the end it all helped to form the pattern of what could be expected from a certain job, the number that were going to be obtained in the mould, and so on. Also, with regard to the building up of experience, the castability of the alloy in question might be difficult. Regarding specialization, it could not be expected that all quotations should be within 3 per cent. of one another. Marginally, company A might be technically better at casting than company B—the process of company A might be more suitable for making small parts than large ones. Mr. Fowkes' firm had quoted recently 24s. for a part, and the order was placed at less than half. The reason was that it was not suitable for the firm's set-up. However, an estimate was prepared, qualified by a statement that, although they could make it, it was not really the firm's kettle of fish. In the course of time, things would fall into a pattern, and some companies would be more successful in obtaining orders for smaller parts, whereas others would specialize in larger parts.

Difficulty with Fettling Costs

MR. I. L. GWYNN (P. I. Castings, Limited) said that he was in sympathy with Mr. Humphreys' comments on costs of costing. It seemed a very high price to pay to get the information by the method suggested, bearing in mind the relatively small size of the foundry with which Mr. Gwynn was associated. The costing at his firm was very simplified, he said. The wax pattern, mould production, fettling and inspection were taken as four distinct and separate departments, and costs estimated and allocated accordingly. Of these, the department which gave greatest difficulty in estimating and costing was the fettling section, but this was quite common in the foundry industry.

MR. FOWKES replied that his firm, too, was troubled by this department—it was an expensive luxury. Fettling accounts formed a large proportion of the cost of an investment casting. The best approach to the reduction of fettling costs was to make castings as well as possible; the wax patterns being without distortion or flash if possible. While his firm did not want to supply castings which looked unsightly, they had to do their best to get away with it as much as they could. Surface finish was very important from the selling point-of-view, but was not always the criterion, and they had found agreement could be reached with the customer on the standard of finish and the amount of fettling necessary. As regards the hiding of scrap, it had been found possible to control the floor staff so that they could not hide it. There was as much floor control as possible, so that things did not get out of hand. This was a necessary evil.

MR. GWYNN then asked how Mr. Fowkes obtained his scrap estimates beforehand.

MR. FOWKES said that that was the responsibility of his technical staff, who did it step by step by means of what they called the engineering quotation. For example, there might possibly be a liability to some form of shrinkage, or they might expect a sinking here or there—they tried not to have to allow for bad cut-off, etc., and depended on shop floor control to avoid same. Fettlers generally were semi-skilled people, and his firm tried to restrict the operations any one man had to do. The fettlers were not given a wide variety of different jobs—if a man were cutting off, then he was cutting off, and if he were knocking flash off, he was knocking flash off, and that was that. His firm depended mainly on technical people to assess, by their own experience, the amount of scrap to be expected after casting.

D. R. WOOD, M.A., A.I.M.

Discussion of the Conference Paper :

Investment-cast Alloys for High-temperature Service*

It is clear, from the comments and questions recorded, that investment founders are somewhat apprehensive that laboratory-developed alloys may be lacking in "castability"—for want of a better term—and that increasing necessity for vacuum casting of alloys might only add to the founders' difficulties. Corrosion-resistance, and blades for small industrial gas-turbines, were amongst other subjects discussed.

After Mr. Wood had presented his paper, entitled "Some Investment-cast Alloys for High-temperature Service," the session chairman (Mr. G. A. Tomkinson of D. Napier & Son, Limited), called for the first contribution to the discussion.

MR. R. TAYLOR (Firth-Vickers Stainless Steels, Limited), opened by saying many people, including himself, were very grateful for this paper containing, as it did, just the highlights of a vast field of technology and enabling production personnel to keep up to date with general developments.

As one who had had his fair share of the anguish and frustration that were the lot of the investment caster, when it came to attempting to make complex shapes in "temperamental" alloys, he would like to make two comments: (*i*) It could not be too strongly emphasized that it was of little or no avail for the research metallurgist to formulate an endless variety of alloy compositions in the search for ever-higher specific properties, if good castings could not be made in this alloy, and (ii) in the research into, and development of, high-temperature investment-cast alloys, it was impossible for the metallurgist to co-operate too closely with the investment founder. He said this because much information about the high-temperature behaviour of an alloy which became evident in the foundry was difficult to put into words. For example, it was no coincidence that Mr. Wood mentioned that H. R. Crown max. and X40 alloys had outstanding thermal-fatigue resistance, and that these same two alloys were singled out as having probably the best "castability." The investment-foundry technologist saw here in his mind's eye the particular virtue of such alloys that enabled him to make a good casting, although the geometry or the component might seem to "ask for trouble." The example showed the crudity and inadequacy of words; "thermal-shock or fatigue resistance," "good castability" (and, one might also add, "good weldability") were apparently unrelated terms and yet were in fact attempts to describe the same physical phenomena.

The Severest Test!

The severest test a jet-turbine blade-casting got throughout its life was, really, the one it suffered during the process of "being born," namely, cooling from the molten state to "knock-out" from the mould. If the alloy could stand up to that, there was hope for it. If it could not—without chronic tearing and shrinkage troubles—then it might as well be abandoned as useless for high-temperature service, at least from the thermal-shock and weldability aspects.

Similarly, if an alloy could cool from the molten state in an air-containing mould and yield excellent smooth surfaces, there was reason to believe that it would not fail in terms of oxidation resistance.

By observing the investment-cast results of making a variety of shapes and sizes in an experimental alloy, under varying production conditions, the high-temperature-materials' metallurgist could acquire a useful background of fundamental information (difficult to put into words, and not obtainable from the usual series of laboratory tests), but which would help to accelerate progress in the field.

Mr. Wood had made it clear that the iron-base alloys had been superseded by the cobalt-base alloys, and that nickel-base alloys appeared to have superseded cobalt-base alloys. Further, the carbide-phase type of matrix-stiffening was superseded or augmented by the Ti/Al type. The graphs of mechanical properties illustrated this, but it was to be regretted that the introduction of the Ti/Al-complex had seriously detracted from the excellent castability in air which was associated with similar alloys not containing elements with such high affinity for oxygen. He was referring to the severe scumming and oxide-film-entrapment troubles met with on air-casting the Nimocast type of alloy.

Vacuum-, or inert-gas-casting techniques might be, or have to be, the answer, but he was sure that all investment founders preferred alloys which did not need "molly-coddling," and would live in the hope that research had not yet completely exhausted the potentialities of the periodic table. Investigators might yet find a combination of elements which gave the same or better all-round properties, as well as good castability, without recourse to the

* Paper presented at the first annual conference of the British Investment Casters' Technical Association and printed in the JOURNAL, June 4, 1959. The Author is associated with the Mond Nickel Company, Limited—details of his career were given in the JOURNAL at the end of his paper.

Discussion on Mr. Wood's Paper

exclusion of air from the melting and casting operations.

Effect of Inhibitors and Chlorides

MR. J. E. P. DOLL (Spartan Steel & Alloys, Limited), asked if Mr. Wood could give any information on the effect of modern inhibitors used in high-temperature boilers, steam turbines, etc., on investment-cast materials,

MR. D. R. WOOD could not answer in terms of the alloys mentioned in his paper, as few, if any, of these had been used for these applications.

MR. MEERKAMP VAN EMBDEN (Philips' Gloeilampenfabrienken, Holland), asked was there a difference in the resistance to chlorides in solution between iron-base, nickel-base and cobalt-base alloys.

MR. WOOD replied that there was no short answer to this question. The type of corrosion encountered, whether general or localized, depended upon the environment, *i.e.*, concentration, temperature and degree of aeration. Again, corrosion resistance was markedly affected by alloying. For many practical conditions, however, stainless-steels served well, whilst nickel/chromium alloys were strongly resistant to aerated chloride solutions.

Blades for Automobiles?

MR. I. L. GWYNN (P. I. Castings, Limited), referring to Mr. Beesley's comments on the previous evening, when it had been indicated that the aero-industry tended to lead what could be regarded as the general-engineering industry, asked if Mr. Wood could give members some indication of when the investment founder was likely to be called upon to produce turbine blades for the automobile industry.

MR. WOOD said he wished he knew! He thought the day of the mass-produced, small turbine was not so very far off. Its development was probably proceeding faster in the United States than in Europe and there were several designs of quite economical, small turbines available in the US which might appear in large numbers in a few years' time.

However, the application for them in Europe would appear to be less in the small passenger car than in machinery which required higher horsepower. The field in which the small gas-turbine looked like competing almost immediately with existing forms of engines was in the 200-h.p.-and-upwards class.

Apprehension about Vacuum Melting

MR. N. WALKER (Hadfields, Limited), reported that most investment casters were becoming increasingly apprehensive about the need for vacuum melting and inert-gas melting of high-temperature alloys. Were there any prospects of developing high-temperature alloys possessing the tolerance to permit normal commercial casting procedures?

MR. WOOD did not think it was impossible, and considered that perhaps a review in about two years' time would present a different position because research was taking place in this field both in the U.K. and in the United States. However, at the present time, no cobalt- or nickel-base alloys had appeared with the same excellent castability of X40 alloy, combined with improved strength and good ductility.

MR. L. S. TAYLOR (G. L. Willan, Limited), said his firm had had some experience with vacuum casting of high-temperature Nimonic-type alloys and it was reassuring that rejection rates—which were matters very close to the heart of the investment founder—were significantly lower, principally due to the elimination of oxide-film inclusions. If one had to use vacuum melting, involving additional capital outlay, at least one obtained something in return.

He asked Mr. Wood what would be an engineering acceptance level for ductility on the high-temperature alloys described in the paper. Figures of 3 per cent. had been mentioned as probably being unsatisfactory; what was a satisfactory level?

MR. WOOD replied that, in this matter, acceptable ductility appeared to vary with the type of application. Thus certain components, such as gas-turbine blades, had been made successfully from super-strength alloys having elongation values below 5 per cent. For other components, such as integrally-bladed rotors, however, in which very high thermal stresses were set up and persisted throughout the life of the component, about 5 per cent. was likely to be the lower tolerable limit. Ideal ductility was probably from about 6 to 10 per cent.; above that, a material was too ductile.

(This closed the discussion on Mr. Wood's Paper).

Conference Paper Author . . . .

Mr. J. I. Evans, whose contribution to the annual conference of the Investment Casters' Technical Association was printed in the September 3 issue of the JOURNAL, is attached to Monsanto Chemicals, Limited. He was educated at Pontypridd Grammar School from 1940 to 1946, and at University College of South Wales, Cardiff, from 1946 to 1950, where he gained a B.Sc. degree with Honours Chemistry, and completed the teachers' training course, receiving a teaching certificate and a diploma of education. His final year at university was spent at University College, Aberystwyth, where he carried out research under Professor C. W. Davies and gained an M.Sc. degree for a thesis on ion pair formation. From 1951 to 1954 he served as a flight lieutenant in the Education Branch of the Royal Air Force, instructing in elementary radio theory. On leaving the Forces in 1954 he joined the development division of Monsanto Chemicals, Limited, at Fulmer, Bucks, where products studied have included ethyl silicate, synthetic latices, P.F. resin adhesives and P.V.C. plasticizers.

News in Brief

OVER THE PERIOD 1958-61, French steel output is to be raised by 27 per cent., aluminium production by 28 per cent., and electrical power by 17 per cent., states a French Government communiqué.

REINFORCED PLASTIC DEVELOPMENTS (makers of "Dolphin" plastics shower cubicles) have taken over new and larger premises at Old Town Wharf, Swan Street, Isleworth, Middlesex; 'phone Isleworth 6319.

A NEW branch office for the British Wagon Company, Limited, at 19, Ravendale Street, Scunthorpe, Lincs (telephone: Scunthorpe 2860), opened on September 21 under the management of Mr. J. R. Farnell.

BRASSFOUNDERS (GRIMSBY), LIMITED, of 12-14, Bath Street, Grimsby, have joined the George Tucker group of companies. As well as operating their non-ferrous foundry, the company are stockists of metals in rod, tube and sheet.

DURING THE PAST FEW WEEKS, export orders placed with Guy Motors, Limited, Wolverhampton, totalled more than £500,000. These included one from Poland for 11 six-wheel tippers, and another was from the Johannesburg Municipal Transport Department for 20 Rolls-Royce diesel-engined buses.

AT THE FIRST MEETING of the new High Authority of the European Coal and Steel Community lots were drawn to determine members' length of office. Six-year terms will be held by the new president, Mr. Malvestiti, vice-president, Mr. Spierenburg, and the West German member, Dr. Potthoff.

GLASGOW IS TO HAVE its first smokeless zone on October 15. Four hundred families live in the central area which will be declared a smokeless zone this month, but the order for an extension of the zone to take in one square mile of the city is expected to be granted by next March and come into force the following October.

A HISTORY of the Cutlers' Company from 1906 to the present day is being written by Dr. L. du Garde Peach, it was revealed at the Forfeit Feast in the Cutlers' Hall, Sheffield, on September 25, when there were 300 guests present. The Master Cutler, Mr. J. Hugh Neill, said the book would be published soon by private subscription.

A NEW SAFETY TRAINING CENTRE for foremen and others in the building industry—and the first to be established in the north of England—was opened on September 25 at the Government Training Centre, Aintree, Liverpool. The opening ceremony was performed by Mr. T. W. McCullough, O.B.E., Chief Inspector of Factories.

IN FACE OF KEEN CANADIAN and European competition, the South Durham Steel and Iron Company, Limited, have been awarded a contract worth approximately $1,500,000 (about £565,000) for the supply of steel pipe and sheet piling to British Columbia for the foundation work of the Port Mann bridge. Delivery of all the material must be completed by the end of this year.

TWEEDALES AND SMALLEY, LIMITED, textile-machinery makers, Castleton, near Rochdale, have secured a contract worth £90,000 for the supply of textile machinery to Jugoslavia, Israel and Australia. The firm is also to manufacture industrial and marine air-conditioning and refrigeration equipment which will provide work for about 500 extra men.

AN ARRANGEMENT has been made between Batignolles-Chatillon and Blondel-Millspaugh for the rationalization of manufacture and sale of machinery for the paper industry in France and other countries. For this purpose a new company is to be formed with the co-operation of Millspaugh, Limited, Sheffield, and Escher Wyss, Ravensburg, West Germany.

SHEFFIELD UNIVERSITY METALLURGY DEPARTMENT has received a grant of £36,000 from the Government-sponsored Department of Scientific and Industrial Research for three new research instruments. They are a high-resolution electron microscope (£11,000), and X-ray scanning micro-analyser (£16,500), X-ray equipment for fluorescence analysis (£8,000) and auxiliary apparatus.

NEW CONVEYOR COMPANY, LIMITED, of Smethwick, has secured, in face of keen competition, a $1,000,000 (approx. £357,000) contract for seven-and-a-half miles of conveyor for a South American ore-handling plant. It is stated that one of the key factors in the winning of the contract was the short delivery date which the firm, a subsidiary of Tube Investments, Limited, was able to offer.

DEMONSTRATIONS of the uses and applications of nickel and nickel-alloys will be given at an exhibition to be held by the Mond Nickel Company, Limited, at Marlands Hall, Southampton, from October 27 to 30. The exhibition will be open daily from 10 a.m. to 7 p.m. (except Friday when it closes at 5.30 p.m.), and admission will be by ticket, free of charge on application to Dr. O. P. Einerl (hon. secretary, IBF Southampton section), c/o John I. Thornycroft & Company, Limited, Woolston, Southampton.

THE EXPORT CREDITS GUARANTEE DEPARTMENT announces that it is prepared, in appropriate cases, to insure capital goods business with Yugoslavia on terms of credit extending to five years from date of shipment. Hitherto for this market the limit has been three years from shipment. ECGD liability under this new cover will be 75 per cent. of loss for all risks covered. This relaxation is intended to enable UK manufacturers of capital equipment to continue to compete for business in Yugoslavia, now that the recent (February, 1959) UK Government loan is fully committed.

CHEMICAL CONSTRUCTION (G.B.), LIMITED, and Dorr Oliver, Limited, have recently commissioned a plant producing SO_2 gas for sulphuric-acid manufacture using by-product ferrous sulphate at the Grimsby works of British Titan Products Company, Limited. The plant which decomposes dried ferrous sulphate with coal in fluidized bed roasters, was designed and built by Chemico using Dorr Oliver Fluo solid reactors. The product SO_2 gas is converted to SO_3 for sulphuric-acid production and the residue is relatively pure iron oxide which can be readily used by the steel industry.

PRODUCTIVITY and the means of increasing Britain's industrial output during the next seven years was the theme of the Annual Conference of the British Junior Chamber of Commerce, which opened at Hull on September 25, and continued over the weekend. Nearly 60 centres in the country were represented. Amongst views put forward were increased co-partnership of employees, including that of administration, and the need to face the increase in the labour force due to the school-leaving "bulge," was also referred to. Delegates from Northamptonshire said that too much standardization would destroy the individualistic approach to business; they excluded, however, the larger industries of steel, ship production, aircraft and cars. The latter industries, they said, would probably derive more benefit from standardization since they were concerned with trading nation against nation, not against each other.

Film Review

Industrial Electric Heating. Available free on loan from the Electrical Development Association, 2, Savoy Hill, London, W.C.2, in both 16- and 35-mm.—sound and Eastmancolor running time 30 min.

A "film within a film," entitled "Industrial Electric Heating," was shown to representatives of industry and the Press in London last week. It deals quite extensively with the theory and practice of electric process heating of all kinds in most industries. The story opens with a film director being commissioned to make a film on industrial electric heating, a subject of which he is completely ignorant. He is shown making a first approach to Mr. Brewer, a manufacturer of electrical heating equipment, who agrees to help him. Brewer takes the director on a quick tour of his works, and a van standing in a nearby loading bay suggests a theme for the film. By showing some of the processes in the manufacture of the motor car, and its component parts, it is decided to illustrate the various methods of electrically heating different materials, in processes ranging from the preparation of raw materials to the painting of the finished product. The director accepts an invitation to join the firm's training class, to learn something about the basic electrical heating methods—arc-, induction-, dielectric-, and resistance-heating.

In a subsequent meeting, Brewer suggests other firms who could provide shots for the film and runs through several case histories which make the film director realize that there are few heating problems that electricity cannot solve, and where productivity cannot be improved. Other industries—ceramics—plastics—furniture—chemicals—in which electrical heating plays a notable part, are discussed and added to the director's notes. And so the film is made—not an exhaustive list of all possible applications of electrical heating methods, nor a detailed picture of any one process, but a brief survey of the advantages of applying electricity to various heating processes.

Produced for EDA by Verity Films, Limited, the film was, on the whole, very good indeed, with spectacular photography and first-class acting by the two principals.

Obituary

The death occurred on September 18 at the age of 73 of Mr. ALFRED BEEBE, formerly cashier with B. & S. Massey, Limited, Openshaw, Manchester. When he retired in 1954, Mr. Beebe had completed 54 years' service with the company.

Mr. JOHN ANDERSON, foreman brass moulder with the Carron Company, Falkirk, a position he had held for the past four years, has died at the age of 47. He served his apprenticeship as a brass moulder with Smith & Wellstood, Limited, Bonnybridge, and later worked in Ayr and Glasgow, returning to his home town to serve with Bonnymuir Foundry and Henry Russell & Company, Limited, Falkirk.

Mr. DOUGLAS S. GARDINER, a director and works manager of Glenfield & Kennedy, Limited, hydraulic engineers, etc., of Kilmarnock, has died at the age of 42. A son of Mr. Henry Gardiner, a former managing director of the company, he was chairman of the Kilmarnock district of the Engineering and Allied Employers' Association and represented the district on the general Council and management board of the Engineering and Allied Employers' National Federation.

Iron-ore Imports

Imports of iron ore and concentrates (except chrome iron ore and roasted iron pyrites) in August, and the totals for the first eight months of this year and last, are shown in the table below. The figures for 1959 are not completely comparable with those for 1958.

From	Month ended August 31.	Eight months ended August 31.	
	1959.	1958.	1959.
	Tons.	Tons.	Tons.
Sierra Leone	82,730	510,236	470,152
Canada	372,750	1,383,022	1,357,990
Other Commonwealth countries and Eire	7,566	2,397	17,166
Sweden	232,642	2,250,650	1,936,001
Norway	12,454	197,710	168,452
France	34,709	341,401	305,288
Portugal	20,767	92,580	147,001
Spain	49,981	447,342	348,279
Algeria	68,900	1,029,210	917,124
French West Africa	30,411	279,560	163,604
Tunisia	35,320	411,287	343,723
Morocco (excluding Tangier) ..	17,630	368,263	247,958
Liberia	23,090	196,219	236,663
Venezuela	149,677	1,059,434	829,619
Brazil	53,550	395,910	368,723
Other foreign countries	13,862	177,478	112,952
TOTAL	1,206,039	9,142,699	7,970,695

Board Changes

TUNGSTEN MANUFACTURING COMPANY (1958), LIMITED—Mr. R. A. P. Johnson has joined the board.

CAMMELL LAIRD & COMPANY, LIMITED—Admiral Sir Michael M. Denny has been appointed a director.

CONSOLIDATED ZINC CORPORATION, LIMITED—Mr. Maxwell I. Freeman has been appointed a director.

MIRRLEES WATSON COMPANY, LIMITED—Mr. James M. Lauder, secretary, has been appointed a director.

RENOLD CHAINS, LIMITED—Mr. W. V. Foley, who is going to Australia to become chairman of the company's subsidiaries there, has resigned from the board.

EVERED & COMPANY, LIMITED—Mr. C. H. Wilson has been appointed managing director, Mr. H. J. Bailey deputy managing director, and Mr. J. D. Hollingworth a special director.

DORSET IRON FOUNDRY COMPANY, LIMITED—Mr. William W. Brooks, previously general manager and technical director of M. & W. Glazebrook, Limited, has been appointed managing director.

BIRMID INDUSTRIES, LIMITED—Mr. W. N. Sherlock retired at the end of last month as a director and secretary of the company and a number of its subsidiaries after more than 40 years with the group. His successor as secretary of Birmid Industries is Mr. F. S. Taylor.

Mr. Ernest Parramore, chairman and managing director, F. Parramore and Sons (1924), Limited, iron-founders, Chapeltown, Sheffield, presented gold watches to three employees on the completion of 30 years with the firm on September 25. The recipients, all from the foundry section, two of whom started at the works straight from school, were Mr. ALBERT EVANS a foreman in the coreshops; Mr. ERNEST FOWEATHER and Mr. HARRY CLARKE, both moulders.

Personal

Mr. N. C. WEAVER has resigned from the board of S. Guiterman & Company, Limited.

Mr. L. H. CLEAVER, whose firm acts as secretary for a number of foundry employers' associations, has been nominated as a candidate for the Yardley division of Birmingham.

Mr. DAVID B. CRAIG, of David Craig & Sons, Limited, steel and ironfounders, Edmonstone Foundry, Millerhill, Edinburgh, has been admitted to membership of the Edinburgh Merchant Company.

Mr. A. H. THOMAS, who is manager of purchasing, stores, and raw material control of British Belting & Asbestos, Limited, at Cleckheaton, has been elected president of the Purchasing Officers' Association for 1959/60.

Mr. JOHN E. COLEMAN, M.I.E.E., has relinquished his directorship and major share-holdings in Spesco Developments, Limited (makers of plastics for packaging containers), which will in future be controlled by Imperial Chemical Industries, Limited.

Mr. P. ALLAN CHARLESWORTH, B.SC., a director of Electropol Processing, Limited, and managing director of the Patent holding company for the process, Electropol, Limited, Poynton, Cheshire, is at present on a tour of the United States of America.

Mr. E. F. CHOPPEN has been appointed a director of Esso Petroleum Company, Limited. He joined the company as a chemist in 1930 and became manager of the co-ordination and economics department in 1957, a position he has now relinquished.

Mr. E. W. HARDIMAN has been appointed general manager (marketing) of the Esso Petroleum Company, Limited. He succeeds Mr. W. H. CRITCHLOW who has been appointed to the boards of Cleveland Petroleum Company, and Esso Petroleum Company (Ireland).

Deputy general manager of the David Brown machine-tool and tool divisions, at Park Road Works, Lockwood, Huddersfield, Mr. A. MAUGHAM, retired on September 30 after 28 years with the company. He was appointed to his present position in 1944 and became a local director in 1956.

Sir JOHN M. BROCKLEBANK, who is a director of Charles Howson & Company, Limited, the Liverpool shiprepairers and engineers, and a member of the Mersey Docks and Harbour Board, is the new chairman of the Cunard Steam-Ship Company, Limited, and Cunard White Star, Limited.

Mr. DAVID N. WARD, of Sheffield, a sales representative for the English Electric Company, Limited, for the North Western Electricity Board area, has been appointed domestic-appliance area manager in the Eastern Electricity Board area. He is succeeded in the North Western area by Mr. C. WOOD.

Sir JAMES MILNE has been elected chairman of the Council of the British Shipbuilding Research Association in succession to Sir James McNeill. Col. T. EUSTACE SMITH, chairman and managing director of Smith's Dock Company, Limited, Middlesbrough (Yorks), has been elected vice-chairman in succession to Sir James Milne. The appointments are for two years.

Mr. L. R. MORTIMER has been appointed south-eastern counties representative of Kelvin & Hughes (Industrial), Limited. He succeeds Mr. A. R. MEWITT who is now assistant technical sales manager. Mr. Mortimer has been a contracts engineer with Kelvin Hughes for the past two-and-a-half years, before which he served in a similar capacity with Bailey Meters, Limited.

Mr. A. B. SKEVINGTON, Nottingham area manager of the electrical appliances division of Philips Electrical, Limited, is to take over the day-to-day running of the Nottingham branch due to the continued ill-health of the manager, Mr. N. R. Law. Mr. R. SEERS, TV and radio division representative in the east Midlands, succeeds Mr. Skevington and is himself succeeded by Mr. E. W. CLARKE, lighting division representative in Nottingham.

Dr. NORMAN LOVELESS, who is a lecturer in psychology at Queen's College, Dundee, has been appointed as a consultant to Smiths Aircraft Instruments, Limited. The growing application of experimental psychology to equipment design has from the first been closely associated with the problems of aircraft instrumentation, since it was recognized during the last war that the pilot's ability to respond quickly and accurately to information could be improved by scientific study of his capacities.

Mr. H. D. MACMURRAY and Mr. T. S. LING, senior directors of George Scott & Son (London), Limited, of the Balfour group of companies, have left this country for overseas. Mr. Macmurray is making a world sales tour, which will include visits to the United States, Canada, New Zealand, India and Australia, and Mr. Ling will visit Canada and the United States for discussions with companies of the Balfour group in those countries. It is expected that both men will be away for approximately two months.

Mr. S. R. HOWES, O.B.E., retired from the board of the United Steel Companies, Limited, on September 30. He was appointed a director in June, 1956, and assumed special responsibility for the company's then newly-created department of operational research and cybernetics. Mr. Howes was formerly a director and general manager of Samuel Fox & Company, Limited, a United Steel subsidiary. He remains managing director of Templeborough Rolling Mills, Limited, in which the company has a financial interest.

Hepworth & Grandage, Limited, of Bradford, announce the following senior staff changes: Mr. R. M. WATERHOUSE, who for the past four years has been assistant sales manager of the home market replacement division, has been appointed assistant export sales manager; Mr. W. G. ROGERS, formerly assistant sales manager of the home market manufacturers' original equipment division, has assumed responsibility for both phases of home-market sales, under Mr. C. H. MALLINSON, home sales manager.

The President of the Board of Trade has appointed Dr. F. LLEWELLYN SMITH, M.SC., M.I.MECH.E., and Mr. I. W. MACDONALD M.A., C.A., to be part-time members of the National Research Development Corporation. Dr. Llewellyn Smith is managing director of the motor-car division of Rolls Royce, Limited, and a director of Bentley Motors (1931), Limited, Park Ward & Company, Limited, and Franco-Brittanic Autos, Limited. Mr. Macdonald is chairman of the National Commercial Bank of Scotland, Limited, and of Lloyds & Scottish Finance, Limited. He is also a director of the Scottish Mutual Assurance Society, and a member of the South of Scotland Electricity Board. Dr. Llewellyn Smith and Mr. Macdonald take the places of Sir JOHN DUNCANSON and Sir ROWLAND SMITH, who are leaving the Corporation on the expiry of their periods of appointment. Sir John Duncanson has been a member of the Corporation since its establishment in 1949; and Sir Rowland Smith has been a member since 1951.

Pig-iron and Steel Production

Statistical Summary of June Returns

The following particulars of pig-iron and steel produced in Great Britain are from statistics issued by the British Iron and Steel Federation. Table 1 summarizes activities during recent months. Table 2 gives production of steel ingots and castings in June. Table 3, weekly average production of finished steel in May. Table 4 gives the production of pig-iron and ferro-alloys in June, and furnaces in blast. (All figures are weekly averages in thousands of tons).

TABLE 1.—*Iron and Steel Price Index and General Summary of Pig-iron and Steel Production.*

Period.	B.o.T. Price Index, 1938 = 100. Iron and steel.	Coal.	Basic materials excl. fuel[1]	Iron-ore output.	Imported ore used.	Coke sent to blast-furnaces.	Pig-iron ferro-alloys prod.	Scrap used in steel prod.	Steel (incl. alloy). Imports.[2]	Prod. ingots, castings.	Delivrs. finished steel.	Stocks.[3]
1957	328	488	537	325	303	270	275	220	14	417	322	1,444
1958	343	503	478	276	262	227	245	196	9	369	284	1,542
1958—Nov. ..	341	509	476	289	237	210	234	187	5	352	281	1,563
Dec.[4]	341	509	473	269	230	206	223	166	4	314	239	1,547
1959—Apl. ..	342	504	476	299	219	201	231	211	5	387	297	1,459
May ..	342	487	478	292	236	203	240	211	8	385	285	1,457
June[4]	338	487	475	285	232	204	235	214	9	388	—	1 451

TABLE 2.—*Average Weekly Production of Steel Ingots and Castings in June, 1959.*

District.	Open-hearth. Acid.	Open-hearth. Basic.	Bessemer.	Electric.	All other.	Total. Ingots.	Total. Castings.	Total ingots and castings.
Derbys., Leics., Notts., Northants. and Essex ..	—	4.1	13.6 (basic)	1.9	0.1	18.3	1.4	19.7
Lancs. (excl. N.W. Coast), Denbighs., Flints. and Ches.	0.9	35.0	—	4.7	0.2	39.5	1.3	40.8
Yorks. (excl. N.E. Coast and Sheffield)								
Lincs.	—	43.3	—	—	0.1	43.3	0.1	43.4
North-East Coast	0.6	65.2	—	1.2	0.4	65.8	1.6	67.4
Scotland	1.5	31.6	—	2.3	0.1	33.7	1.8	35.5
Staffs., Shrops., Worcs. and Warwicks.	—	16.1	—	3.7	0.8	18.8	1.8	20.6
S. Wales and Monmouthshire	1.9	90.3	7.3 (basic)	0.8	0.1	100.0	0.4	100.4
Sheffield (incl. small quantity in Manchester) ..	8.5	34.2	—	12.1	0.3	53.4	1.7	55.1
North-West Coast	0.1	1.0	4.0 (acid)	0.5	—	5.5	0.1	5.6
Total	13.5	320.8	24.9	27.2	2.1	378.3	10.2	388.5[4]
May, 1959	12.2	319.3	25.7	25.5	1.9	375.3	9.3	384.6
June, 1958	16.0	308.8	24.5	21.9	2.4	362.7	10.9	373.6

TABLE 3.—*Deliveries of Non-alloy and Alloy Finished Steel.*

Product.	1957.	1958.	1958. Apr.*	1958. May.	1959. Apr.	1959. May.
Non-alloy steel:						
Ingots, blooms, billets, and slabs[5]	5.0	4.6	5.1	4.8	6.0	5.1
Heavy rails	11.2	10.2	11.8	10.7	8.2	7.3
Sleepers	1.3	1.2	1.5	0.7	1.5	0.5
Fishplates and soleplates	0.8	0.7	0.9	0.6	0.5	0.6
Plates:						
(i) Over ⅜ in. thick	34.0	29.6	33.5	34.8	25.4	23.8
(ii) Under ⅜ in. ..	20.3	17.7	18.6	18.9	17.4	18.8
Other heavy prod. ..	53.0	41.8	54.7	49.0	39.9	41.4
Ferro-concrete bars ..	8.9	7.6	6.9	8.1	8.7	8.7
Wire rods	23.3	21.5	18.8	19.7	24.5	24.2
Arches, etc.	11.0	8.6	10.4	9.8	8.9	8.5
Other light sections ..	38.7	29.1	30.5	27.3	32.6	30.5
Bright steel bars ..	7.0	6.2	6.2	6.3	7.7	7.1
Hot-rolled strip ..	23.1	22.6	22.0	21.6	27.3	26.9
Cold-rolled strip ..	7.1	7.0	7.3	6.6	7.8	7.3
Sheets, incl. coated:						
(i) Hot-rolled ..	13.0	10.6	11.5	10.1	10.4	10.1
(ii) Cold-reduced ..	29.1	31.1	29.4	28.2	38.8	34.7
Tinplate:	18.8	18.7	19.6	19.2	21.5	20.5
Blackplate	1.0	0.8	0.9	0.7	0.6	0.6
Tubes up to 16 in. ..	22.1	19.0	18.3	19.1	20.9	18.1
Tube, pipe fittings ..	0.5	0.4	0.3	0.3	0.4	0.4
Tyres, wheels, axles	5.1	4.5	5.0	4.9	3.0	2.6
Forgings (excl. drop)	3.1	2.6	2.8	3.1	2.4	2.5
Steel castings	4.6	4.2	4.3	4.1	3.9	3.7
Tool and magnet ..	0.3	0.2	0.2	0.2	0.2	0.3
Total	342.3	300.5	320.5	308.8	318.5	304.2
Alloy steel	17.8	16.1	16.1	18.1	19.1	17.4
Total deliveries from UK production[6]	360.1	316.6	336.6	326.9	337.6	321.6
Add: Imported finished steel	9.6	7.1	7.2	8.4	9.7	8.3
	369.7	323.7	343.8	335.3	347.3	329.9
Deduct: Intra-industry conversion[7]	48.2	41.2	41.9	41.1	51.1	46.5
Total deliveries new material	321.5	282.5	301.9	294.2	296.2	283.4

TABLE 4.—*Production of Pig-iron and Ferro-alloys*

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derbys, Leics, Notts, Northants and Essex	17	0.5	20.4	16.9	1.2	—	39.0
Lancs (excl. N.W. Coast), Denbighs, Flints, and Ches ..	7	—	21.6	—	—	1.4	23.0
Yorks (excl. N.E. Coast and Sheffield)	—	—	—	—	—	—	—
Lincs	8	—	39.8	—	—	—	39.8
North-East Coast	17	3.0	39.8	—	—	0.7	43.5
Scotland	5	0.2	13.2	0.6	—	—	14.0
Staffs, Shrops, Worcs, Warwicks	4	—	5.6	0.9	—	—	6.5
S. Wales and Monmouthshire	10	2.8	49.5	1.0	—	—	53.3
Sheffield	2	—	3.5	—	—	—	3.5
North-West Coast	7	11.6	—	0.2	—	0.9	12.7
Total ..	77	18.1	193.4	19.6	1.2	3.0	235.3[4]
May, 1959 ..	80	19.0	198.5	17.3	1.4	4.3	240.5
June, 1958 ..	88	23.7	193.4	22.0	0.6	3.5	243.2

[1] Used in non-food manufacturing industries.

[2] Weekly average of calendar month.

[3] Stocks, mainly ingots and semi-finished, at the end of the year and months shown.

[4] Five weeks, all tables.

[5] Other than for conversion into any other form of finished steel listed.

[6] Includes finished steel produced in the UK from imported ingots and semi-finished steel.

[7] Material for conversion into other products also listed in this table.

Raw Material Markets

Iron and Steel

Changes of detail in some of the Iron and Steel Board's maximum price schedules became effective on Monday. The changes have no appreciable effect on the overall level of iron and steel prices. Certain weight and quality extras chargeable by plate producers have been reduced. Minor changes have been made in alloy forging ingot extras applicable to special purpose steels. The extras chargeable for small quantity sales by producers trading as stockholders have been increased in some cases. Alterations have been made in the basic, hematite, and foundry iron schedules. and, in particular, prices will in future include delivery from railway stations to works without additional cost to consumers.

The formula under which the prices of strip mill tinplate are varied in accordance with the average price of tin has been modified so as to eliminate narrow changes in the prices of tinplate. In consequence, the prices of strip mill tinplate which would have risen to-day (Thursday) under the previous formula will not now do so. Maximum price control has been removed from the relatively small quantities of tinplate, tinned sheets, and blackplate still produced in hand mills.

The level of output at the ironfoundries varies according to the type of castings produced and the amount of business available from the trades for which they cater. For some considerable time the call for high-duty castings has been foremost. The engineering and speciality foundries supplying to the motor vehicle industry have benefited because the demands from that industry have been maintained at a high rate and requirements show no diminution; in fact, some of the delivery schedules have been stepped up.

From steelworks and some sections of the engineering trade improved demands for castings are now forthcoming. The machine-tool trade, while showing signs of improvement, is not yet specifying the tonnage of castings previously consumed and the foundries which mainly produce for that trade are generally short of work, as also are the foundries depending on the orders for castings for railway equipment.

In the light-castings trade, many of the foundries continue to obtain improved outputs, due to the higher demand for domestic utensils. From the building trade there has also been some improvement, which, it is hoped, will be maintained, although seasonal influences may later have an adverse effect. The jobbing foundries are fairly well employed, but the foundries catering for the textile trades are only moderately employed.

All grades of pig-iron are plentiful, apart, perhaps, from certain brands of low-phosphorus pig-iron. Alternatives of equal analysis and price are available, however.

There continues to be an appreciable demand from the engineering foundries for low-phosphorus irons, and those in need of hematite and refined irons are readily supplied. Makers of high-phosphorus pig-iron have tonnages to spare, and the foundries using this grade are able to obtain supplies promptly and in the quantities required. Consignments of pig-iron, mostly in the high-phosphorus range, continue to be shipped, but prices have to be at a low level to obtain the business against strong competition from overseas producers.

The re-rollers maintain their improved level of production and demands for small bars and light sections, together with reinforcing rods, are keeping the mills fully employed. The expansion in the requirements of steel semis continues and most home steelworks have sufficient orders on hand to cover outputs for several weeks ahead. This position is likely to persist—and it may even become more acute—until the re-rollers are able to replenish their meagre stocks in addition to obtaining the necessary supplies of billets, blooms, etc., to implement the work on hand. Arisings of suitable defectives and crops at the steelworks are readily absorbed.

Non-ferrous Metals

Non-ferrous metals continue to be dominated by the strike position in the United States. On the one hand, the strike in the copper industry, which is tying up about 75 per cent. of production capacity, can be regarded as a bullish influence, as stocks are decreasing rapidly and the prospect of a shortage of metal in the not too distant future is now a reality. In fact, this position is made much grimmer by the possibility of a strike in the El Teniente mine in Chile and a dock strike in the US, both of which are half expected to start to-day (Thursday). In the ordinary course of events the price of copper would be rising rapidly on both sides of the Atlantic. However, the steel strike in the US has been going on now for so long that its overall effect on the US economy is the stronger of the two influences—so far, anyway—and the price has not changed very much in London and not at all in the US, where custom smelters continue to quote 33 cents and producers 31½ cents a pound.

It may well be that the stock position is still considered to be high enough to allow consumers to play their game of "wait and see" a little longer before being forced into the market. The outlook, therefore, is somewhat uncertain. In so far as the steel strike is concerned, the belief is growing that it will require the intervention of President Eisenhower invoking the Taft-Hartley Act to bring the steelworkers back into operation before agreement is reached. Some observers feel that if this is done the copper mines may also resume production. In any event, both strikes look like going on for another couple of weeks, by which time copper stocks in the hands of US consumers will be either exhausted or nearly so.

In London, the market is sensitive to conditions prevailing on the other side of the Atlantic, and the quotation is fluctuating narrowly. The feature of the London market this week, perhaps, was the unexpected rise in copper stocks by 425 tons to 13,238 tons.

Tin, though continuing reasonably steady, is showing a weaker undertone than for some time past. This is attributed to the bleak outlook for the settlement of the steel strike which will curtail consumption of the metal and to the beginning of the new quota period to-day (Thursday). It is believed that the buffer stock manager has been selling metal in the market on account of the British Government. Tin stocks last week showed a small rise of 34 tons and now stands at 8,594 tons.

In the United States, the price is not far short of $1.03 a pound.

Lead is without feature on either side of the Atlantic. In London lack of interest has pushed the quotation below £70 a ton. In the US, the market is also dull and the price is called 13 cents a pound. Zinc, too, has come under the influence depressing the non-ferrous metal markets. Lack of consumer interest has shaded the price slightly. However, demand is still satisfactory and the fact that the backwardation still exists reflects a shortage of nearby metal. In the US, the quotation remains unchanged at 12 cents a pound.

Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

September 30, 1959

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2, 10-ton lots or over: Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.40 per cent. P, 10-ton lots or over, £23 5s. 0d., delivered Birmingham, £23 10s. 0d., delivered Grangemouth.

Cylinder and Refined Irons.—North Zone, £25 6s. 6d.; South Zone, £25 9s. 0d.

Refined Malleable.—P, 0.10 per cent. max.: North Zone, £26 6s. 6d.; South Zone, £26 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent., 10-ton lots or over: N.-E. of England (local iron), £24 14s. 0d.; Scotland (Scotch iron), Zone S.1, £25 0s. 6d.; Sheffield, £26 2s. 6d.; Birmingham, £26 9s. 0d.; Wales (Welsh iron), £24 14s. 0d.

Basic Pig-iron.—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leicestershire, in 10-ton lots or over.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £40 0s. 0d. to £42 10s. 0d., scale 15s. 0d. per unit, lumpy; 75 per cent. Si, £54 0s. 0d. to £57 10s. 0d., scale 15s. 0d. per unit, lumpy.

Ferro-vanadium.—50/60 per cent., 22s. 6d. per lb. of V

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 10d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £287 0s. 0d.

Ferro-tungsten.—80/85 per cent., 11s. 9d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 14s. 9d. per lb. of W.

Ferro-chrome (6-ton lots and over, lumpy). —4/6 per cent. C, £77 0s. 0d. to £81 0s. 0d., basis 60 per cent., Cr, scale 26s. 0d. to 27s. 6d. per unit; over 6 per cent. C, £74 10s. 0d. to £77 10s. 0d., basis 60 per cent. Cr, scale 26s. 0d. to 27s. 6d. per unit; 2 per cent. C,* 1s. 7½d. to 1s. 10½d. per lb. Cr.; 1 per cent. C,* 1s. 8d. to 1s. 11d. per lb. Cr; 0.15 per cent. C,* 1s. 9d. to 2s. 0d. per lb. Cr; 0.10 per cent. C,* 1s. 9½d. to 2s. 0½d. per lb. Cr; 0.06 per cent. C,* 1s. 9¾d. to 2s. 0¾d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 6s. 10d. per lb.

Metallic Manganese.—94/96 per cent., carbon-free, £245 0s. 0d.; 96/98 per cent., £275 0s. 0d.

Ferro-columbium.—65/67 per cent., Cb + Ta, 19s. 9d. per lb., Cb + Ta.

Ferro-manganese (Standard).—78 per cent., £66 0s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC. Soft u.t., 100 tons & over, £31 15s. 6d.; tested, 0.08 to 0.33 per cent. C, 6 to 35 tons, £33 15s. 6d.; hard (0.41 to 0.60 per cent. C), under 10 tons, £34 17s. 0d.; silico-manganese, under 10 tons. £43 16s. 6d.; free-cutting, under 10 tons, £36 14s. 6d. SIEMENS MARTIN ACID (under 10 tons): Up to 0.25 per cent. C, £41 1s. 0d.; silico-manganese, £44 4s. 0d.

Billets, Blooms, and Slabs for Forging and for Stamping (under 10 tons).—Basic, soft, up to 0.33 per cent. C, £38 10s. 0d.; basic hard, over 0.41 up to 0.60 per cent. C, £39 12s. 6d.; acid, up to 0.25 per cent. C, £43 4s. 0d.

FINISHED STEEL

Heavy Plates and Sections (under 10 tons).—Ship plates, (N.-E. Coast), £42 2s. 0d.; boiler plates (N.-E Coast), £44 12s. 0d.; floor plates (N.-E. Coast), £43 11s. 0d.; angles (N.-E. Coast), £39 16s. 6d.; joists (N.-E. Coast), £39 12s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., and flats 5 in. wide and under, untested soft basic, 50 tons and over, £39 1s. 0d.; under 10 tons to 4 tons, £40 18s. 0d.; under 4 tons to 2 tons, £41 3s. 0d.; hoop and strip, coils, 100 tons and over, £38 0s. 0d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., 25 tons to under 50 tons, £43 16s. 0d.; black sheets (hand mill), 24g., 10 tons and over, £57 14s. 6d.; galvanized corrugated sheets, 24g., 10 tons and over, £67 4s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £68 10s. 0d.; nickel-chrome, £99 4s. 0d.; nickel-chrome-molybdenum, £111 17s. 0d., in lots of 5 tons to under 10 tons.

NON-FERROUS METALS

Copper.—Cash, £227 0s. 0d. to £227 5s. 0d.; three months, £228 0s. 0d. to £228 5s. 0d.; settlement, £227 5s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 2⅝d. per lb.; rods, 244s. 6d. per cwt. basis; 20 s.w.g., 279s. 6d. per cwt.

Tin.—Cash, £793 10s. 0d. to £794 0s. 0d.; three months, £793 0s. 0d. to £793 10s. 0d.; settlement, £794 0s. 0d.

Lead (Refined Pig).—Second half September, £69 10s. 0d. to £69 12s. 6d.; second half December, £70 17s. 6d. to £71 0s. 0d.

Zinc.—Second half September, £87 5s. 0d. to £87 15s. 0d.; second half December, £85 10s. 0d. to £85 15s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £121 0s. 0d.; rolled zinc (boiler plates), all English destinations, £118 15s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £101 0s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 10¼d. per lb.; sheets to 10 w.g., 196s. 0d. per cwt.; wire, 2s. 7⅛d.; rolled metal, 196s. 0d. per cwt.

Brass (Brazing).—BS1400, B3, £152; B6, £198.

Brass (High Tensile).—BS1400, HTB1, £183; HTB2, £197; HTB3, £212.

Gunmetal.—BS1400, LG2, £188; LG3, £197; G1, 1%, £248; G1, 1%, £236.

Phosphor Bronze.—BS1400, PB1 (AID released), £284; BS1400, 90/10/1, £263.

Leaded Phosphor Bronze.—BS1400, LPB1, £208.

Phosphor Bronze Strip, etc.—Strip, 282s. 6d. per cwt.; wire, 4s. 0d. per lb.; rods, 3s. 3¾d.; tubes, 3s. 3¾d.; chill cast bars: solids 3s. 3¼d.; cored 3s. 4¼d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 9½d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 2½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 1½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 3d. per lb. Antimony, English, 99 per cent., £190 0s. 0d. Quicksilver, ex-warehouse, £71 10s. 0d. Nickel, £600 0s. 0d. Aluminium, ingots, £180 0s. 0d.; aluminium bronze (BS1400), AB1, £232; AB2, £244.

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Company News

A drop of over £1,000,000 in the group net profits for the six months to June 30, 1959, was due, states the half-yearly report of VICKERS LIMITED, to declining sales of aircraft, continued slackness in certain sections of the English Steel Corporation, Limited, lack of recovery in Canadian heavy engineering and shipbuilding, and by further provision for development costs of new aircraft. While the group's engineering business and shipyards are active and there are signs of some gradual improvement in steel and Canadian interests, the second half-year's profits are likely to show little change.

Sales for the half-year (excluding sales within the group) amounted to £73,030,000 (£89,480,000) and the group net profit contracted to £1,780,000 (£2,870,000). The full year's sales for 1958 totalled £176,850,000 and the profit £6,590,000. The interim dividend is maintained at 2½ per cent., a total of 10 per cent. having been paid for 1958.

PEERLESS & ERICSSON, LIMITED, food preparing machinery manufacturers, of London, N.W.9.—The preference dividend due to-day, will not be paid.

BENNIS COMBUSTION, LIMITED—There is no ordinary dividend for the year to April 30, 1959. In the previous year there was an interim of 2½ per cent., but no final. Group trading profit, after writing back provisions not required on contracts not yet completed, is £23,671 (£7,468).

GLOUCESTER RAILWAY CARRIAGE & WAGON COMPANY, LIMITED—Group profits for the year ended May 31, 1959, fell to £393,580 (£493,686), and after tax of £193,647 (£267,553), the net profit is £206,952 (£227,239). The dividend is repeated at 15 per cent. with a 10 per cent. final.

DOMINION STEEL & COAL CORPORATION, LIMITED (controlled by A. V. Roe, Canada, Limited)—The directors have declared a dividend of 10 cents per share, payable October 28. Payments of 25 cents quarterly have been made previously. The reduction, it is stated, is attributable to the "extremely tight credit situation and substantial expenditure programme now in progress."

ASSOCIATED ELECTRICAL INDUSTRIES, LIMITED—A second interim of 6d. per £1 unit is declared, making 1s. per unit to date, as before. A total of 3s. per unit was paid on a smaller capital for 1958. In the half-year to June 30, 1959, group trading profit (unaudited) rose to £7,750,000, compared with £6,990,000 in the first half of 1958. Group net profit, before tax, was £5,010,000 (£4,840,000).

PLESSEY COMPANY, LIMITED, radio, electronic, and instrument manufacturers, of Ilford (Essex)—The offer to shareholders of 3,600,000 10s. ordinary shares at 23s. 6d. per share met with acceptances totalling over 99 per cent. Applications were received for nearly 800,000 additional shares. Basis of allotment for the additional shares is that applicants for up to 10 shares receive allotment in full and applicants for over 10 shares each receive 10 shares.

CAMBRIDGE INSTRUMENT COMPANY, LIMITED—An unchanged quarterly interim dividend, payable on September 30, of 6d. per £1 share, tax free, was announced. The chairman, Dr. P. Dunsheath, stated that no alteration was anticipated in the interim dividend to be paid in the current year, but an adjustment of the final dividend may be expected. Demand for the company's products was satisfactory, he adds, and recent developments are producing additional orders. New 22,000 sq. ft. research laboratories are to be opened at Cambridge on October 14, and a 9,000 sq. ft. extension at the Muswell Hill works will shortly be occupied.

CAMMELL LAIRD & COMPANY, LIMITED, shipbuilders, marine engineers, and boilermakers, etc., of Birkenhead—The interim dividend is cut from 4 to 3 per cent. and members are warned that a considerable reduction in the group profit for 1959 must be anticipated. With a special interim, the effective total payment for 1958 was 15 per cent. on the one-class £5,325,000 ordinary capital. Results of the subsidiary, Cammell Laird & Company (Shipbuilders & Engineers), Limited, will be adversely affected by the inter-union disputes which occurred earlier in the year. At the Patent Shaft Steel Works, Limited, although there has recently been some improvement in the order position, prolonged difficulties in bringing the new plant into production have so far prevented the works from operating at a profit.

SERCK, LIMITED—The company has acquired the whole of the share capital of the Visco Engineering Company, Limited, Croydon. The purchase consideration is the issue to the Visco shareholders of 55,570 new 5s. ordinary shares in Serck, together with a cash payment of £222,804 financed out of the company's current resources. The Visco company manufactures filters, air heaters, heating, ventilating, and air-conditioning plant, and water and oil coolers, etc., its products being complementary to some of those already manufactured in the Serck group. Visco profits over the last three years have averaged approximately £60,000 per annum before tax, and it is anticipated that this acquisition will provide a useful addition to the group profits in the future. In order to level up the ordinary capital of the company, the board has also sold through its official brokers a further 3,430 new ordinary shares of 5s. each at the current market price and the resulting premium is being placed to capital reserve account.

Increases in Capital

JESSOP-SAVILLE (SMALL TOOLS), LIMITED, Sheffield, increased by £88,000, in £1 ordinary shares, beyond the registered capital of £2,000.

G.W.B. FURNACES, LIMITED, Dudley (Worcs), increased by £250,000, in £1 ordinary shares, beyond the registered capital of £250,000.

DAVY-UNITED, LIMITED (formerly Davy & United Engineering Company, Limited), Sheffield, increased by £2,000,000, in £1 shares, beyond the registered capital of £2,000,000.

HOLT, SIRON & COMPANY, LIMITED, manufacturers and casters in brass, etc., of Birmingham, increased by £35,000, in £1 ordinary shares, beyond the registered capital of £15,000.

BURGESS ENGINEERING (STOKE-ON-TRENT), LIMITED, iron masters and founders, etc., of Alsager (Staffs), increased by £4,500, in £1 ordinary shares, beyond the registered capital of £500.

FOLLSAIN, LIMITED (formerly Follsain-Wycliffe Foundries, Limited), Lutterworth, near Rugby, increased by £110,000, in 140,000 6 per cent. non-cumulative preference shares of 10s. and 200,000 ordinary shares of 4s. each, beyond the registered capital of £170,000.

ROTARY HOES, LIMITED, West Horndon (Essex), increased by £350,000, in 5s. ordinary shares, beyond the registered capital of £900,000.

METAL BOX COMPANY, LIMITED, London, W.1, increased by £5,000,000, in £1 ordinary shares, beyond the registered capital of £20,000,000.

P. I. CASTINGS (ALTRINCHAM), LIMITED, Altrincham (Ches), increased by £65,000, in £1 ordinary shares, beyond the registered capital of £35,000.

EAST SUSSEX ENGINEERING COMPANY, LIMITED, Lewes (Sussex), increased by £25,000, in £1 ordinary shares, beyond the registered capital of £25,000.

JOHN ACKWORTHIE, LIMITED, machine-tool makers, etc., of Kenilworth (Warwickshire), increased by £10,000, in £1 ordinary shares, beyond the registered capital of £15,000.

ASQUITH MACHINE TOOL CORPORATION, LIMITED, Halifax, increased by £150,000, in £1 new 6 per cent. cumulative preference shares, beyond the registered capital of £3,083,500.

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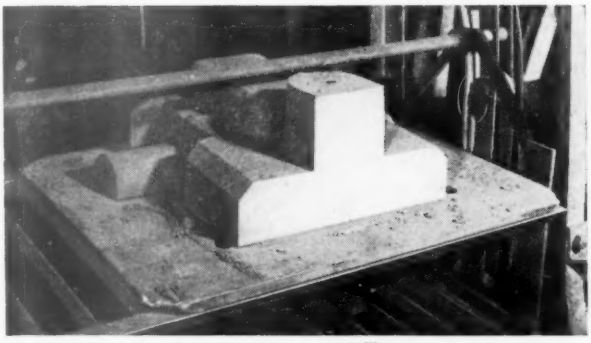

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Publications Received

The Ward Group of Companies—Products and Services. Published by Thos. W. Ward, Limited, Albion Works, Savile Street, Sheffield.

When a group has 45 subsidiary and associated companies, plus 25 branch works, there is obviously a need for a publication covering all the activities and services undertaken. The connection of the Ward group with the foundry is indeed intimate, as castings are made in several plants. Others supply non-ferrous ingots, moulding sands, foundry plant, and protective clothing, whilst Thos. W. Ward are also important pig-iron and coke merchants. Yet in this 68-page beautifully illustrated brochure, these activities take up but two or three pages. The rest is a fascinating story of the growth of a gigantic, world-wide organization in less than 100 years, from what was originally a local coal-merchant's business. The weakest part of the publication is the index, which is by no means comprehensive. The use of the term "sandblast" can, so far as this country is concerned, be regarded as virtually archaic, except perhaps in connection with the use of zircon sand. The publications department of Thos. Ward, Limited, is to be congratulated on the work they have done in turning out such an excellent brochure.

GEC Export Guide, Vol. III, No. 3. Issued by the Economic and Marketing Research Unit of the General Electric Company, Limited, Magnet House, Kingsway, London, W.C.2.

This issue, which in the usual manner covers over 30 product groups for a like number of countries, makes more-cheerful reading, for whereas in the previous issue of the *Guide* in April, prospects were good in 13 countries, the number has now risen to 14. Improving conditions are noted in ten countries as against eight; deterioration is now shown in six markets (before it was eight), whilst in the last category—bad prospects—the description now applies to only four countries (an improvement of one). The *Guide* states that improved conditions exist in Argentina, Australia, Belgium, Denmark, Italy, Netherlands, Pakistan, USSR and W. Germany. Prospects are not favourable in Iraq, Kenya, New Zealand, Norway, Spain and South Africa.

United Dominions Trust, Limited. Published from United Dominions House, Eastcheap, London, E.C.3.

This 40-page, interestingly illustrated, booklet details the history, growth and activities of a huge company. "Boiled down," the activities consist of moneylending for the acquisition of industrial plant, motor-cars and other goods. If money be needed for foundry plant, it can be assumed that this type of company will finance either the seller or the buyer. This is the second edition of the brochure as, since publication of the first one, Barclays Bank have taken up 1,000,000 new ordinary shares in the company, thus considerably increasing the group's reserves, and rendering the earlier issue obsolete.

Directory of Members. Issued for the Association of Bronze and Brass Founders, by Heathcote and Coleman, 69, Harborne Road, Edgbaston, Birmingham, 15.

This is a very useful publication as, besides being a list of names and addresses, it answers such queries, for example, as to what member-firms make shell-moulded castings and their geographical location, or which foundries are mechanized for repetition castings, which manufacture centrifugal castings, and so on. Any organization operating an information bureau should certainly acquire this Directory as it is a most useful source of information not readily obtainable elsewhere. Purchasing officers will find it a most useful work of reference.

Accidents, No. 40. Published by H.M. Factory Inspectorate, Ministry of Labour and National Service, by Her Majesty's Stationery Office, York House, Kingsway, London, W.C.2; price 1s. 3d. net.

It would appear that the major part of the accidents described and illustrated in this booklet, could have been prevented by the exercise of a modicum of commonsense and foresight, but others do not enter into this category. For instance, one accident is reported involving an electro-magnet, which though switched off, had sufficient remanent magnetism to attract metal and so cause injury to an operator's fingers. Most of the accidents covered in the publication enter into the "unusual" category, but the general lesson to be derived is the need for continuous watchfulness on everybodys part.

New Catalogues

Foundry Plant. J. W. Jackman & Company, Limited, Vulcan Works, Blackfriars Road, Manchester, 3, have issued a series of *Bulletins* covering their manufactures. *Bulletin No. 3*, which deals with coreblowers, moulding machines, and foundry systems, has already been reviewed in the JOURNAL, though, through a misprint, it was referred to as No. 4. *Bulletin No. 4* is actually devoted to compressed-air-operated shot-blast and shot-peening equipment. In its 36 pages, the introduction tells of the various abrasives available; on page 2, four types of equipment are briefly described; and page 3 is devoted to notes on design. Thereafter the four main types are dealt with in detail, including many variations from standard. The *Bulletin* concludes with descriptions of dust-extraction equipment.

Bulletin No. 1, "Combined Shotblasting and Dècoring Equipment," describes a specialized application of shotblast. In this system castings (especially steel castings) are taken to the shotblast chamber straight from the mould, the operation being specially designed to cope with the extra amount of sand involved. The system involves the use of both magnetic collection and demagnetization of useful abrasive and other special features.

Bulletin No. 2 is devoted to hardness-testing machines, and from it, it is surprising to learn of the many variations there are of the standard bench-type Brinell machine. There are machines for the continuous testing of the exterior hardness of tubes, bars and the like, and for ascertaining the hardness of the interior surfaces of tubes and cylinders; other machines deal with thin strip, such as razor blades.

Further *Bulletins* are promised for the future.

Metal Finishing. The metal finishing division of the Pyrene Company, Limited, Great West Road, Brentford, Middlesex, has issued a leaflet covering Endurion. This is an immersion process which imparts to the zinc-phosphate or "Parkerized" surface of ferrous metals a dense, fine-textured, corrosion-resistant finish. An interesting fact is that it is obtainable in a variety of colour finishes, which are useful in the stores for identification purposes. The plant used for this process is quite simple and where Parkerizing is practised, one, or two—in the case of colour work—additional tanks are necessary.

HISTORICAL NOTE

W. J. Mariner & Co. Ltd., of Luton were established in 1909 and have just completed 50 years as Non-Ferrous Founders. They produce castings of very varied types and sizes both in Aluminium and Bronze for all classes of Engineering, and also manufacture very largely for the hatting industry. They are A.I.D. approved.

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Imports and Exports of Iron and Steel in August

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in August. Totals for the first eight months of this year and last are also included.

Total Exports of Iron and Steel

Destination.	Month ended Aug. 31.	Eight months ended August 31.	
	1959.	1958.	1959.
	Tons.	Tons.	Tons.
Cyprus	247	4,332	1,158
Sierra Leone	954	8,960	7,007
Ghana	1,853	9,602	19,768
Nigeria	6,766	44,288	51,200
Union of South Africa	2,406	68,855	28,485
Rhodesia and Nyasaland	1,383	26,071	14,393
Tanganyika	2,532	8,468	12,862
Kenya	3,610	29,220	15,608
Uganda	368	2,237	3,292
Mauritius	123	2,505	947
Aden	255	2,145	2,003
Bahrein, Qatar, and Trucial States	305	6,049	5,210
Kuwait	269	30,639	7,701
India	16,825	90,433	120,702
Pakistan	4,698	43,263	24,378
Singapore	1,568	23,669	14,537
Malaya	589	10,566	7,018
Ceylon	2,837	19,937	30,021
British North Borneo	42	1,500	1,785
Hongkong	3,697	38,156	44,456
Australia	4,937	65,572	54,590
New Zealand	6,515	127,219	61,740
Canada	21,265	129,830	121,226
Jamaica	1,465	13,841	14,717
Trinidad	3,190	34,890	29,250
British Guiana	297	5,223	4,502
Other Commonwealth countries	3,110	25,522	24,682
Eire	4,012	33,285	31,469
Soviet Union	5,707	12,105	13,208
Finland	2,915	34,562	22,980
Sweden	7,193	84,792	74,884
Norway	5,731	60,823	58,160
Denmark	6,541	59,869	62,642
Western Germany	12,375	29,344	75,695
Netherlands	8,707	54,562	64,575
Belgium	2,117	15,202	19,379
France	388	2,750	2,015
Switzerland	723	7,040	5,533
Portugal	793	9,537	10,530
Spain	1,203	34,492	20,318
Italy	2,772	29,449	34,446
Austria	239	7,251	2,347
Yugoslavia	504	3,000	2,280
Greece	878	9,568	7,850
Turkey	362	3,521	4,421
Netherlands Antilles	175	1,312	1,869
Portuguese East Africa	120	1,680	930
Egypt	858	11,673	2,130
Sudan	445	27,261	5,355
Lebanon	79	8,563	1,818
Israel	2,633	5,034	10,378
Saudi Arabia	34	3,498	2,858
Iraq	4,167	24,505	54,960
Iran	4,129	23,807	20,956
Burma	616	6,568	6,271
Thailand	371	5,024	6,048
Indonesia	105	1,542	3,415
Philippine Republic	1,100	2,327	4,177
USA	24,145	52,102	114,627
Cuba	441	3,825	4,921
Columbia	198	4,831	1,734
Venezuela	4,877	52,898	51,452
Ecuador	167	2,032	713
Peru	368	7,665	1,789
Chile	174	3,744	1,089
Uruguay	25	721	730
Argentina	19,787	95,635	142,099
Other foreign countries	14,935	78,113	184,657
TOTAL	235,215	1,782,504	1,860,946

Total Imports of Iron and Steel

From	Month ended August 31.	Eight months ended August 31.	
	1959.	1958.	1959.
	Tons.	Tons.	Tons.
Rhodesia and Nyasaland	998	4,507	3,979
Canada	2,402	14,769	12,156
Other Commonwealth countries and Eire	2,724	16,758	22,078
Soviet Union	6,094	107,701	31,464
Sweden	2,984	23,044	18,218
Norway	8,831	50,031	55,862
Poland	283	173	3,505
Western Germany	9,116	54,042	44,481
Netherlands	7,439	98,072	110,918
Belgium	1,151	79,429	15,677
Luxembourg	178	5,026	4,673
France	965	15,010	14,375
Italy	1,232	4,654	9,286
Austria	169	3,629	2,706
Japan	—	2,544	—
USA	1,247	113,667	19,184
Other foreign countries	1,044	3,574	10,594
TOTAL	46,857	596,630	379,156
Iron and steel scrap and waste, fit only for the recovery of metal	131	57,766	2,642

Exports of Iron and Steel by Products

Product.	Month ended August 31.	Eight months ended August 31.	
	1959.	1958.	1959.
	Tons.	Tons.	Tons.
Pig-iron	12,865	85,629	85,078
Ferro-columbium (niobium)	6	26	32
Ferro-tungsten	38	409	777
Other ferro-alloys	1,274	2,254	4,261
Ingots, blooms, billets, slabs, sheet bars (incl. tinplate bars), and similar primary forms	8,048	8,311	50,578
Pieces roughly shaped by forging*	40	5,265	996
Iron bars, rods, angles, shapes, and sections	65	1,083	815
Steel bars, rods, angles, sections, and shapes	45,399	226,343	260,663
Iron plates and sheets	49	2,030	287
Universal plates	586	3,185	5,200
Steel plates, 3mm. and under 4.5mm. thickness	2,159	5,409	28,762
Ditto, 4.5mm. or more in thickness	12,182	121,958	122,005
Blacksheets and blackplate	20,504	190,374	174,673
Hoop and strip	7,314	43,927	56,690
Tinplate	36,925	243,772	312,746
Decorated tinplate	549	2,334	6,078
Galvanized sheets	6,059	51,232	59,894
Other (incl. tinned sheets, terneplate, and ternesheets)	2,267	8,857	14,804
Railway and tramway construction material	12,138	175,701	110,081
Wire rods of steel (incl. alloy steel)	1,925	23,235	32,523
Wire	7,739	68,169	69,693
Tubes, pipes, and fittings	56,484	513,001	464,310
TOTAL	235,215	1,782,504	1,860,946

* The figures for 1959 are not completely comparable with those for previous years.

A GIFT OF £50,000 has been made by the English Electric Company, Limited, to the new College of Technology at Stafford. It is thought that the money will be used to buy extra equipment and the company has intimated that as equipment becomes out of date it will renew it.

THE REGISTERED office and transfer office of Tipper Industries, Limited, malleable ironfounders, manufacturers of gas, water, and steam tubes, etc., is now at City Centre House (12th floor), 30, Union Street, Birmingham 2.